TC 1000/TC 2000
X.25/ISDN Protocol Emulation
User's Guide

Telecommunications
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TC 1000/TC 2000
X.25/ISDN Protocol Emulation
User's Guide

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The information contained in this manual applies to the Telecommunications Techniques Corporation TC 1000 and TC 2000 Analyzer platforms equipped with System Software Version 11.

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OPERATORS SAFETY SUMMARY

GROUNDING THE PRODUCT

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input terminal. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

DANGER ARISING FROM LOSS OF GROUND

Upon loss of the protective-ground connection, all accessible conductive parts (including controls that may appear to be insulating) can render an electric shock.

USE THE PROPER POWER CORD

Use only the power cord and connector specified for your product. Use only a power cord that is in good condition.

USE THE PROPER FUSE

To avoid fire hazard, only use a fuse of the correct type, voltage rating and current rating specified in this manual.

DO NOT REMOVE COVERS OR PANELS

The TC is not designed for disassembly. Operating the TC without the covers or panels properly installed could result in personal injury or damage to the equipment.

NOTE:
Any attempt to disassemble the TC 1000 will void the product warranty.

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SECTION 1
GENERAL INFORMATION

1.1 EMULATION GUIDE SUMMARY

The *X.25/ISDN Protocol Emulation Guide* is designed for all users of X.25/ISDN emulation, an option of the TC 1000 and TC 2000 Protocol Analyzers. Reading this guide, you can learn about the emulator's features and capabilities, start-up procedures, and functional menus. Additionally, Section 4 offers a variety of X.25 and ISDN emulation applications, with "automatic" menu set-ups for each.

If you require information about X.25 or ISDN protocol emulation, you'll find this guide a useful tool. However, this guide assumes that you are already familiar with the TC 1000 or TC 2000 Protocol Analyzer. If you need information about the analyzer, its features and capabilities are fully described in the *Protocol Analyzer User's Manual.*

1.2 THE X.25/ISDN EMULATION OPTION

As its name implies, *X.25/ISDN Emulation* gives your TC 1000 or TC 2000 the ability to emulate X.25 and ISDN components by automatically controlling the X.25 and ISDN protocols. Specifically, it allows your protocol analyzer to replace a key X.25 or ISDN component, and emulate the way that component would normally operate within your network. Emulation is an ideal troubleshooting tool because, by isolating faulty equipment quickly, you can keep out-of-service test time to a minimum. And when used in installation testing, emulation allows you to evaluate the performance of a new network component and detect problems before they affect live traffic.

1.3 X.25 EMULATION FEATURES AND CHARACTERISTICS

X.25 emulation offers these features and characteristics:

- DTE or DCE emulation
- Automatic Layer 1 and Layer 2 operation (LAPB)
- Layer 3 (packet layer) call set-up and data transfer using simple commands
- Layer 2 and Layer 3 parameter adjustment
- Packet Assembler/Disassembler (PAD) commands
- Customized conformance testing using scripter and protocol macros
- Packetized transmission of keyboard characters to the far end of your circuit

1.3.1 X.25 Application Index

This guide offers the following X.25 applications and associated menu set-ups:

To:	Go to Page:
Learn how to emulate an X.25 network	30
Learn how to emulate an X.25 subscriber	34

1.4 ISDN EMULATION FEATURES AND CHARACTERISTICS

ISDN emulation offers these features and characteristics:

- TE or NT emulation
- Automatic Layer 2 operation (Q.920 and Q.921 standards) (LAPD)
- Call set-up (Q.930 and Q.931 standards)
- X.25 testing on the D-channel
- X.25 testing on the B-channel
- Layer 2 and Layer 3 parameter adjustment
- Customized conformance testing using scripter and protocol macros

1.4.1 ISDN Application Index

This guide offers the following ISDN applications and menu set-ups:

To:	Go to Page:
Learn how to emulate an NT in a AT&T Network (Functional Mode)	38
Learn how to emulate an NT in a Northern Telecom DMS100 network (Functional Mode)	41
Learn how to emulate an NT in a Northern Telecom DMS100 network (Stimulus Mode)	45
Learn how to emulate an AT&T telephone (TE)	48
Learn how to emulate a Northern Telecom DMS100 Meridian Telephone (TE - Functional Mode)	52
Learn how to emulate a Northern Telecom DMS100 Meridian Telephone (TE - Stimulus Mode)	55

SECTION 2
GETTING STARTED

2.1 SECTION SUMMARY

This section of the guide provides the information you need to get started with the X.25/ISDN Emulation Option. It offers detailed information about installation requirements and procedures, the Emulation main menu and its submenus, and keys that control menu movement and operation.

2.2 INSTALLING THE X.25/ISDN EMULATION OPTION

2.2.1 Installation Requirements

To properly install the X.25/ISDN Emulation Option, the following software is *required*:

- version 10.0 of primary system software or higher. Check your instrument's software version by selecting the ADMINISTRATION function from the main menu (F9 key), and Software version from the menu immediately following (D key)
- an external floppy disk drive (TC 1000 only)
- the ISDN basic rate interface (if not installed)

NOTE: If your unit's release of primary system software is *lower than version 10.0*, please call TTC Customer Support (1-800-638-2049) for assistance.

2.2.2 Installation Procedures

The X.25/ISDN Emulation Option is supplied as a software component and is issued on a 3 1/2 inch disk. Table 2-1 describes how you can use this disk to install the Emulation Option.

NOTE: Prior to installation, make sure that the software version of the Emulation Option matches the current version of system software.

Table 2-1
Installing X.25 Emulation Software

Step	Activity
1.	Press the F9 key to select the ADMINISTRATION function from your instrument's main menu.
2.	Press the F key to select Software update from the ADMINISTRATION menu.
RESULT:	The message **Update — Are you sure?** appears on your screen. Press the Y key to start the update procedure.

Table 2-1
Installing X.25 Emulation Software (Continued)

Step	Activity
3.	Insert the Emulation Option disk in your instrument's disk drive and press any key to begin the installation procedure.
RESULT:	When the installation procedure is complete, your instrument is ready for a software reboot.
4.	Start the reboot by removing the Emulation Option disk from the drive and pressing any key.
RESULT:	When the reboot is completed, the main menu appears on your screen.
5.	Press the F4 key to select PROTOCOL ANALYZER from the main menu, then press the A key to select Monitor/Emulate/Record/Playback from the PROTOCOL menu.
RESULT:	The TC PROTOCOL TESTER menu appears on your screen.
6.	Verify that Emulation is listed as a TC PROTOCOL TESTER submenu (shown below Recording).

2.3 SELECTING THE EMULATION OPTION

Figure 2-1 illustrates the TC PROTOCOL TESTER menu.

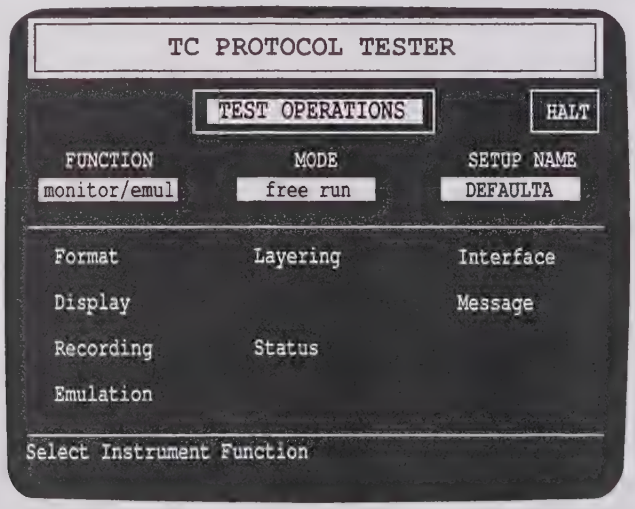


Figure 2-1
TC PROTOCOL TESTER Menu

To select the emulation option, press the Right Arrow or Left Arrow key (the 6 or 8 key on the numeric keypad, respectively) until Emulation is highlighted.

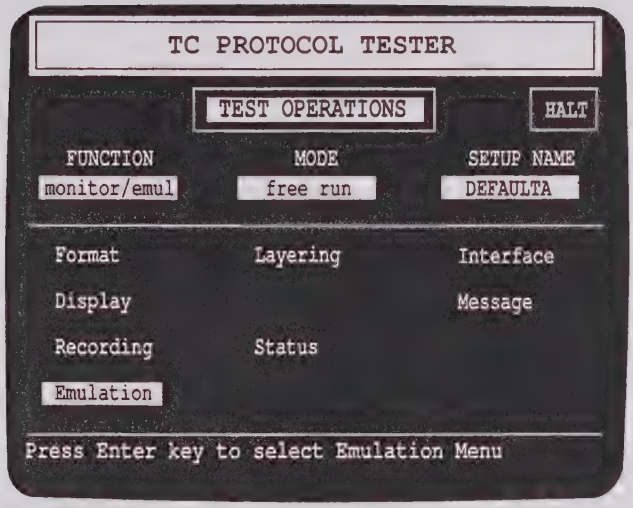


Figure 2-2
Selecting the Emulation Option

To bring the EMULATION main menu into the display, press the ENTER key.

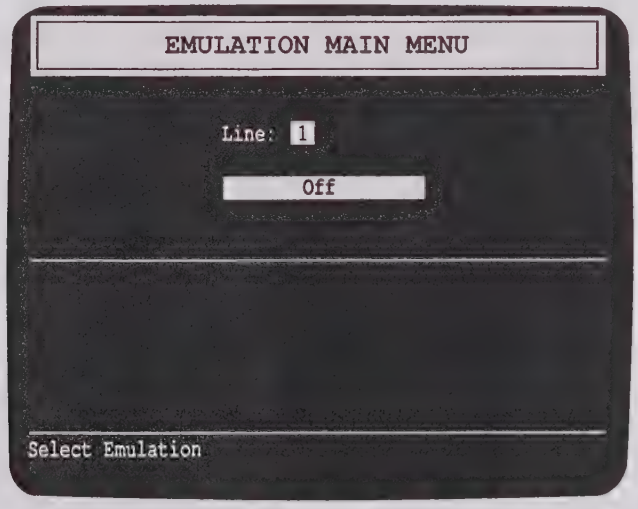


Figure 2-3
The Emulation Main Menu

2.4 EMULATION CHOICES

When the Emulation main menu appears in the display, you can enter any of the option's seven emulation choices. Table 2-2 lists and briefly describes these functions.

Table 2-2
Emulation Choices

To Learn More, Select:	To:	See Page:
Off	"Turn off" ISDN/X.25 emulation	7
ISDN-D Functional	Emulate the TE or NT side of a basic rate ISDN line	8
ISDN-D Stimulus	Emulate the TE or NT side of a basic rate ISDN line in accordance with Northern Telecom stimulus standard	11
ISDN-D X.25 Packet	Emulate the TE or NT side of a basic rate ISDN line and generate Q.921 and X.25 in the D-channel	13
X.25	Emulate the network or subscriber side of an X.25 network	15
LAPD	Emulate a TE/NT or DTE/DCE at Level 2 (Q.921) only	17
LAPB	Emulate a DTE or DCE at Level 2 (HDLC) only	20

2.5 KEYS TO KNOW

Table 2-3 lists the keys that are helpful when setting up for X.25/ISDN emulation. Except where noted, all keys are found on your instrument's numeric keypad.

Table 2-3
Key List

Press The:	To:
Right Arrow (6) key	Move RIGHT through a list of menus, submenus, or parameters
Left Arrow (4) key	Move LEFT through a list of menus, submenus, or parameters
Down Arrow (2) key	Scroll DOWN within a menu, submenu, or parameter selection
Up Arrow (8) key	Scroll UP within a menu, submenu, or parameter selection
Home (7) key	Move to the previous menu screen
Help Key (above numeric keypad)	See the choices that are available within your current menu. This key is particularly useful when you need to view the choices that are available to you in any given run-time screen.
F1 key (top left of function keypad)	Return to the TC 1000 or TC 2000 main menu

SECTION 3
MENU REFERENCE

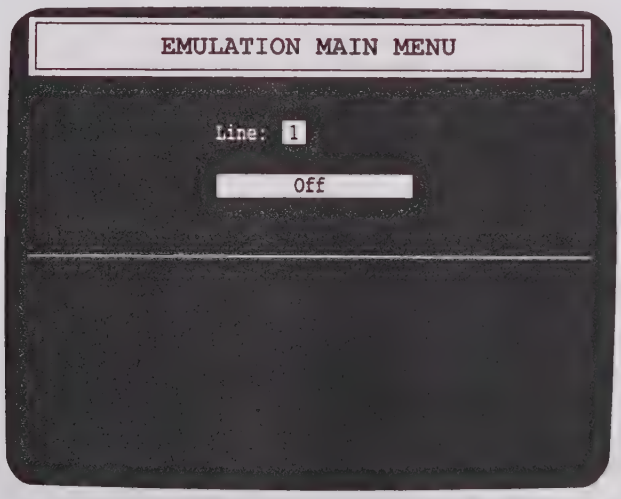
3.1 SECTION SUMMARY

This section of the guide describes the X.25/ISDN Emulation Option's seven functional submenus. Each submenu is presented in reference format, and appears in the order in which it is listed in the HELP screen, as follows:

- Off
- ISDN-D Functional
- ISDN-D Stimulus
- ISDN-D X.25 Packet
- X.25
- LAPB
- LAPD

OFF **OFF**

"Turn Off" X.25/ISDN Protocol Emulation



PURPOSE:

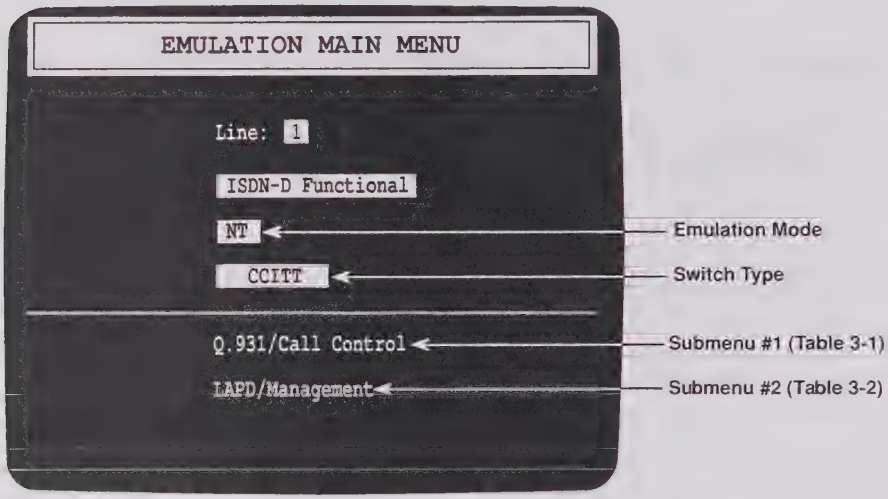
The OFF submenu turns off X.25/ISDN protocol emulation. Select OFF when emulation is not required for the test you wish to run, or your application requires monitoring.

ASSOCIATED MENUS:

None.

ISDN-D FUNCTIONAL ISDN-D FUNCTIONAL

Emulate a Basic Rate ISDN Line in Functional Mode



PURPOSE:

The ISDN-D Functional submenu enables the emulation of the TE or NT side of a basic rate ISDN line in functional mode. When this submenu is selected, LAPD (Q.921 — Layer 2) and Q.931 messages are generated across the D-channel.

TOP-LEVEL CHOICES:

Emulation Mode

TE - Select TE emulation

NT - Select NT emulation

Switch Type

CCITT - Select CCITT switch (Q.921/931 Blue Book standard)

NTI DMS100 - Select Northern Telecom DMS-100 switch (BCS29 standard)

AT&T 5ESS - Select AT&T 5ESS switch (5E4/5/6 standard)

ISDN-D FUNCTIONAL ISDN-D FUNCTIONAL

Emulate a Basic Rate ISDN Line in Functional Mode

APPLICATION SET-UP FILES:

The following application set-up files are already created for ISDN-D Functional emulation:

TENTF	-	Emulate a Northern Telecom telephone (TE) in functional mode
NTNTF	-	Emulate a Northern Telecom NT central office in functional mode
TEATT	-	Emulate an AT&T 7506 ISDN TE
NTATT	-	Emulate an AT&T ISDN NT central office

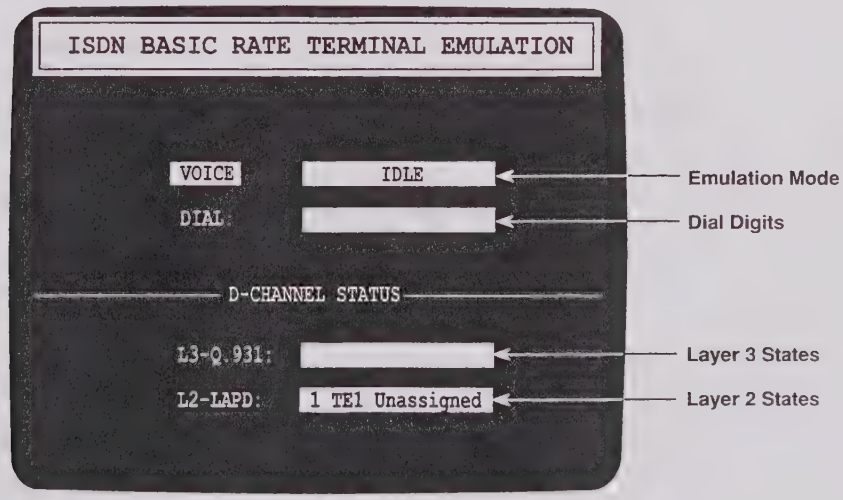
See Section 4.2 for more information about application set-up files.

SUBMENUS:

To Set Up The:	See Table:
Q.931/Call Control menu	3-1 on Page 22
LAPD/Management menu	3-2 on Page 24

RUN-TIME SCREENS:

ISDN Basic Rate Terminal Emulation



ISDN-D FUNCTIONAL **ISDN-D FUNCTIONAL**
Emulate a Basic Rate ISDN Line in Functional Mode

RUN-TIME SCREENS (Continued):

Select:

V = Initiate/accept a voice call
H = Terminate a voice call
S = Send a SPID request
E = Send an EPSM request
X = Send a CRV audit
A = Send a TEI audit

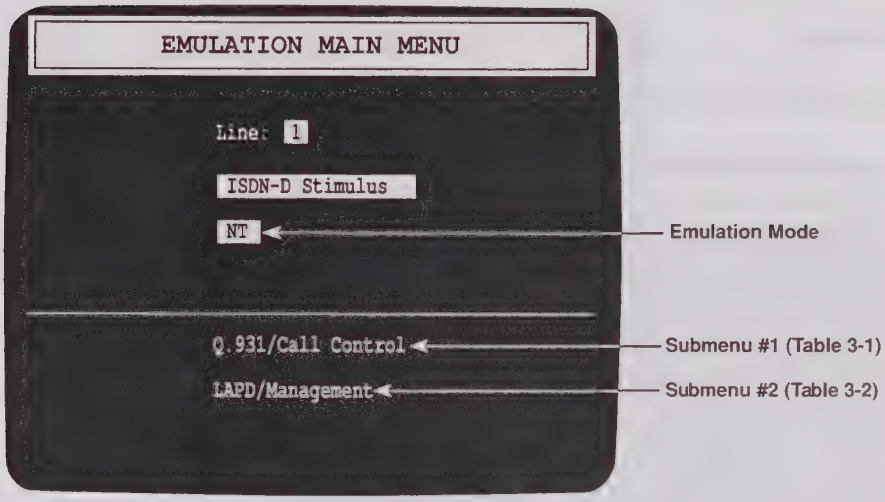
Layer 3 States:

0 Null
1 Call Init
2 Overlap Sending
3 Out Call Proceed
4 Call Delivered
6 Call Present
7 Call Received
8 Connect Request
9 In Call Proceed
10 Active
11 Disc Request
12 Disc Indication
15 Suspend Request
17 Resume Request
19 Release Request
25 Overlap Receive
Idle
Establish Wait

Layer 2 States:

1 TEI Unassigned
2 Assign Await TEI
3 Establ Await TEI
4 TEI Assigned
5 Awaiting Establ
6 Awaiting Release
7 Multiframe Estab
8 Timer Recovery

ISDN-D STIMULUS ISDN-D STIMULUS
Emulate a Basic Rate ISDN Line in Stimulus Mode



PURPOSE:

The ISDN-D Stimulus submenu enables the emulation of the TE or NT side of a basic rate ISDN line in stimulus mode. When this submenu is selected, LAPD (Q.921 — Layer 2) and Q.931 messages are generated across the D-channel in accordance with the Northern Telecom Stimulus standard.

TOP-LEVEL CHOICES:

Emulation Mode

TE - Select TE emulation

NT - Select NT emulation

APPLICATION SET-UP FILES:

The following application set-up files are already created for ISDN-D Stimulus emulation:

TENTS - Emulate a Northern Telecom telephone (TE) in stimulus mode

NTNTS - Emulate a Northern Telecom NT device in stimulus mode

See Section 4.2 for more information about application set-up files.

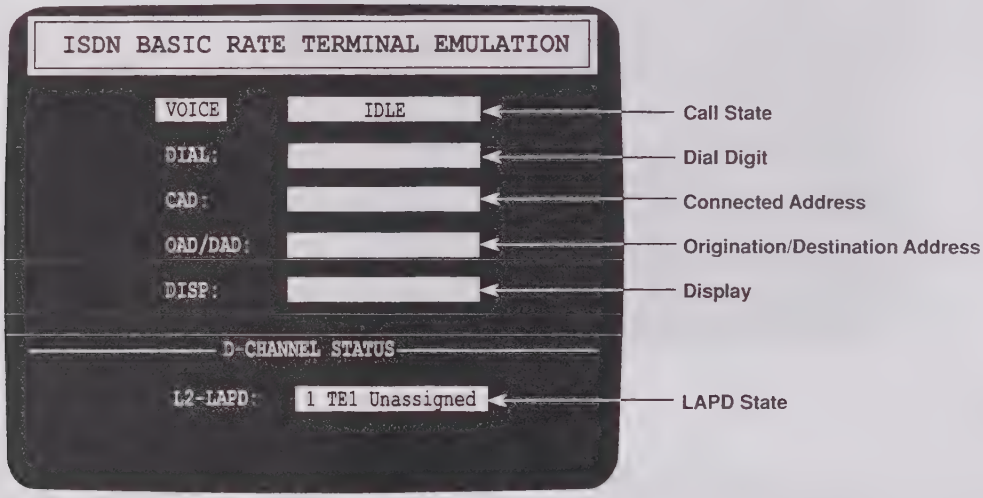
SUBMENUS:

To Set Up The:	See Table:
Q.931/Call Control menu	3-1 on Page 22
LAPD/Management menu	3-2 on Page 24

ISDN-D STIMULUS ISDN-D STIMULUS
Emulate a Basic Rate ISDN Line in Stimulus Mode

RUN-TIME SCREENS:

ISDN Basic Rate Terminal Emulation



Select:

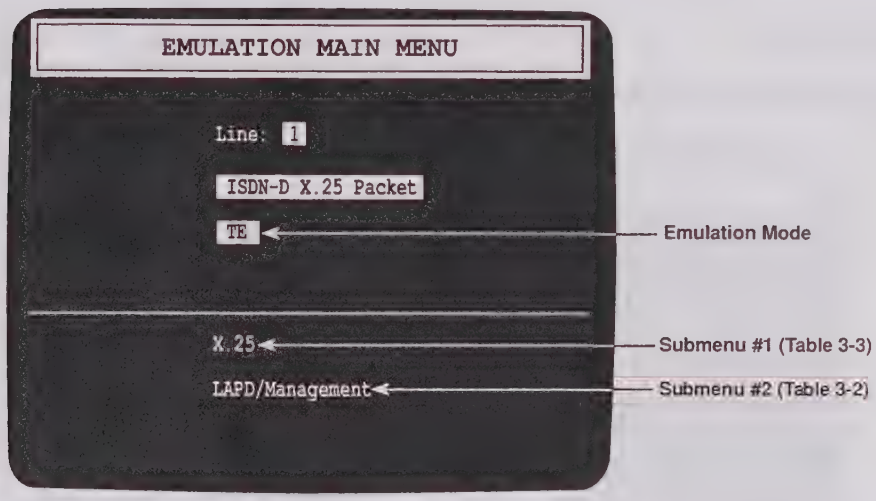
V = Initiate/accept a voice call
H = Terminate a voice call
I = Send Initialize I.E.
A = Send a TEI audit

CAD = Connected Address
OAD = Origination Address
DAD = Destination Address

LAPD States:

1 TEI Unassigned
2 Assign Await TEI
3 Establ Await TEI
4 TEI Assigned
5 Awaiting Establ
6 Awaiting Release
7 Multiframe Estab
8 Timer Recovery

ISDN-D X.25 PACKET ISDN-D X.25 PACKET
Emulate X.25 and LAPD on an ISDN D-Channel



PURPOSE:

The ISDN-D X.25 Packet submenu enables the emulation of X.25 and LAPD on an ISDN-D channel in accordance with Service Access Point Identifier (SAPI) 16. This type of emulation is known as D-channel telemetry.

TOP-LEVEL CHOICES:

Emulation Mode

TE - Select X.25 subscriber emulation

NT - Select X.25 network emulation

APPLICATION SET-UP FILES:

The following application set-up files are already created for ISDN-D X.25 Packet emulation:

X25NET - Emulate an X.25 network

X25SUB - Emulate an X.25 subscriber

See Section 4.2 for more information about application set-up files.

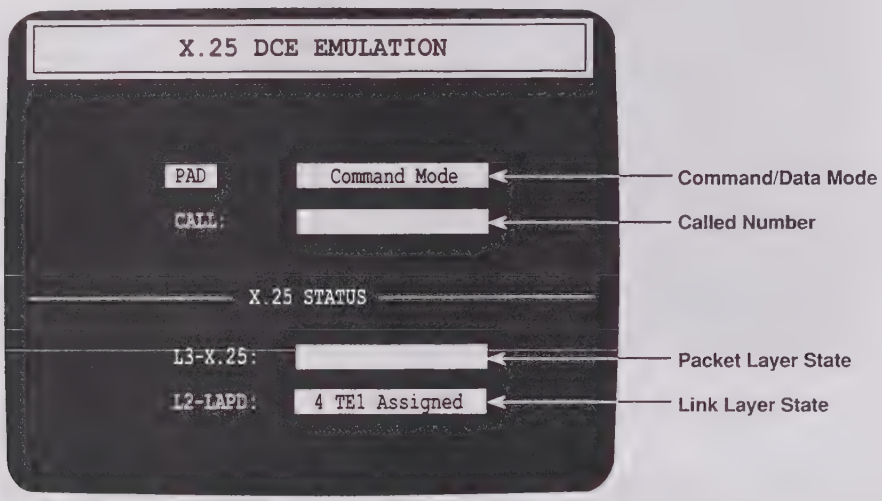
SUBMENUS:

To Set Up The:	See Table:
X.25 menu	3-3 on Page 25
LAPD/Management menu	3-2 on Page 24

ISDN-D X.25 PACKET ISDN-D X.25 PACKET
Emulate X.25 and LAPD on an ISDN D-Channel

RUN-TIME SCREENS:

X.25 DTE Emulation and X.25 DCE Emulation



Select:

D = Initiate a data call
H = Terminate a voice call
R = Send a reset packet
S = Send a restart packet
I = Send an interrupt packet
Enter = Forward a packet
? = Switch between command and data modes

Packet Layer States:

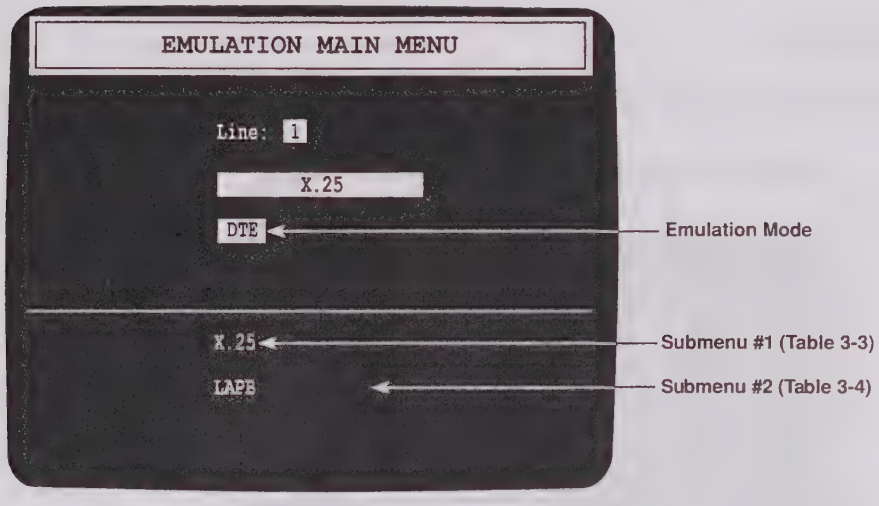
r1 Ready
r2 DTE Restart
r3 DCE Restart
p2 DTE Wait
p3 DCE Wait
p4 Data Transfer
p5 Collision
p6 DTE Clear
p7 DCE Clear
d2 DTE Reset
d3 DCE Reset
Establish Wait

Link Layer States:

1 TEI Unassigned
2 Assign Await TEI
3 Establ Await TEI
4 TEI Assigned
5 Awaiting Establ
6 Awaiting Release
7 Multiframe Estab
8 Timer Recovery

X.25 X.25

Emulate an X.25 Network or an X.25 Subscriber



PURPOSE:

The X.25 submenu enables the emulation of either the network or the subscriber side of an X.25 environment. X.25 emulation can be performed across all data communications interfaces (i.e., RS-232, V.35, and RS-449).

TOP-LEVEL CHOICES:

Emulation Mode

DTE - Select DTE (subscriber) emulation

DCE - Select DCE (network) emulation

APPLICATION SET-UP FILES:

The following application set-up files are already created for X.25 emulation:

X25NET - Emulate an X.25 network

X25SUB - Emulate an X.25 subscriber

See Section 4.2 for more information about application set-up files.

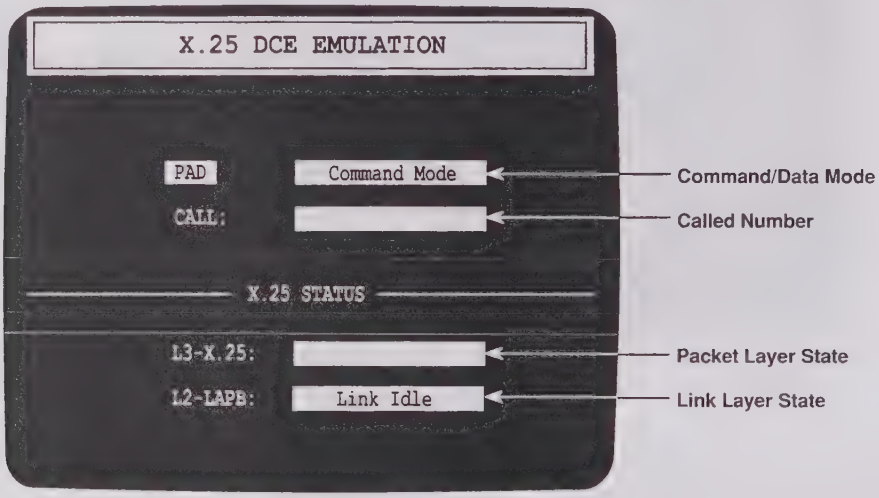
SUBMENUS:

To Set Up The:	See Table:
X.25 menu	3-3 on Page 25
LAPB menu	3-4 on Page 27

X.25 X.25
Emulate an X.25 Network or an X.25 Subscriber

RUN-TIME SCREENS:

X.25 DTE Emulation and X.25 DCE Emulation



Select:

D = Place an X.25 call (data mode)
H = Terminate an X.25 call (command mode)
R = Send a reset packet (command mode)
S = Send a restart packet (command mode)
I = Send an interrupt packet (command mode)
Enter = Forward a packet
? = Switch between command and data modes

Packet Layer States:

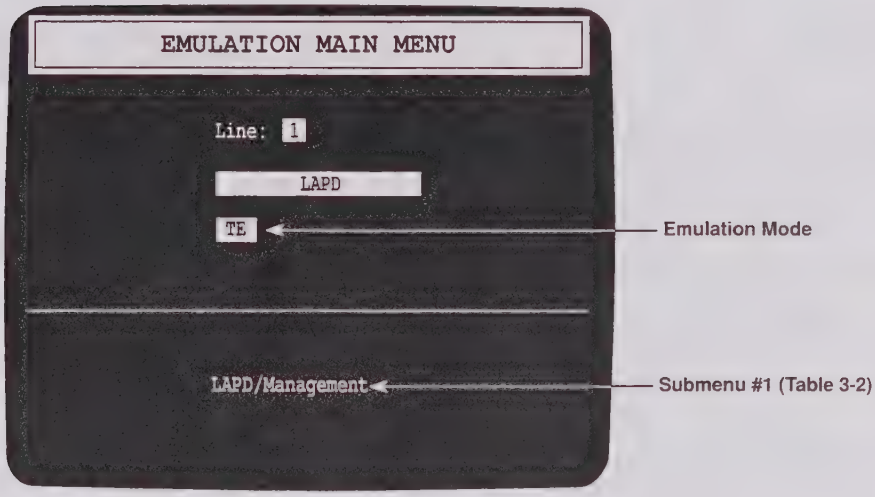
r1 Ready
r2 DTE Restart
r3 DCE Restart
p2 DTE Wait
p3 DCE Wait
p4 Data Transfer
p5 Collision
p6 DTE Clear
p7 DCE Clear
d2 DTE Reset
d3 DCE Reset
Establish Wait

Link Layer States:

1 TEI Unassigned
2 Assign Await TEI
3 Establ Await TEI
4 TEI Assigned
5 Awaiting Establ
6 Awaiting Release
7 Multiframe Estab
8 Timer Recovery

LAPD LAPD

Emulate LAPD Only For NT/TE Devices



PURPOSE:

The LAPD submenu enables the Layer 2 emulation of an NT or TE when testing a basic rate interface. When selected, this feature allows Layers 1 and 2 to be controlled automatically; Layer 3 is manually controlled through scripts which permit "negative" testing (see NOTES).

TOP-LEVEL CHOICES:

Emulation Mode

TE - Select TE (basic rate interface) emulation

NT - Select NT (basic rate interface) emulation

APPLICATION SET-UP FILES:

None.

SUBMENUS:

To Set Up The:	See Table:
LAPD/Management menu	3-2 on Page 24

NOTES:

The LAPD emulation feature permits the automatic control of Layer 1 and Layer 2, while you control Layer 3 manually via scripts. The SEND and RECEIVE primitives enable Layer 3 control.

IMPORTANT: The text immediately following assumes a thorough knowledge of script programming concepts. If you are unfamiliar with these concepts, please consult the *Scripter Reference Manual.*

LAPD LAPD
Emulate LAPD Only For NT/TE Devices

SEND PRIMITIVE:

Syntax:

SEND PRIMITIVE <0-3> WITH MESSAGE <number>

T_PRIM is a variable that is set to one of the following values:

0 = causes a SABM(E) to be sent as a means of entering the Multiframe Established State.

1 = causes a DISC to be sent as a means of entering the TEI Assigned State.

2 = causes an INFO frame to be sent. The associated buffer is inserted in the INFO frame's data field.

3 = causes a UI frame to be sent. The associated buffer is inserted in the UI frame's data field.

Setting SAPI:

L_SAPI is a system variable that, once set, is transmitted in the Layer 2 portion of the frame. Syntax is as follows:

LET VARIABLE L_SAPI = value n

n = 0 for voice
16 for data (X.25)
63 for management

Script Example:

```
        SHOW TEXT SENDING SABME TO TE at row 2 and column 2
        SHOW TEXT SAPI = 16 at row 2 and column 25
        LET VARIABLE L_SAPI = VALUE 16          <———— Assigning a value (16) to SAPI
        SEND PRIMITIVE 0 WITH MESSAGE 0         <———— Sending SABM(E) with SAPI 16
        SHOW TEXT WAITING FOR UA at row 4 and column 2
        RECEIVE PRIMITIVE and don't timeout     <———— Waiting for UA
        IF VARIABLE R_PRIM = VALUE 5 GOTO L2END <———— Receoved IA wotj SA{O 16
L2END   SHOW TEXT RECEIVED UA at row 6 and column 2
        SHOW TEXT "Multiframe Estab" at row 8 and column 2
        END
```

LAPD LAPD

Emulate LAPD Only For NT/TE Devices

SEND PRIMITIVE (Continued):

Sending TEI:

TEI is the value configured in the LAPD emulation submenu.

RECEIVE PRIMITIVE:

Syntax:

RECEIVE PRIMITIVE and don't timeout

R_PRIM is a variable that must be set to one of the following values:

1 = indicates that a SABM(E) has been received and the Multiframe Established State has been entered.

2 = indicates that a DISC has been received and the TEI Assigned State has been entered.

3 = indicates that an INFO frame has been received.

4 = indicates that a UI frame has been received.

5 = confirms the receipt of a UA frame in response to the transmission of a SABM(E) and indicates that the link is up.

6 = confirms the receipt of a UA frame in response to the transmission of a DISC and indicates that the link is down.

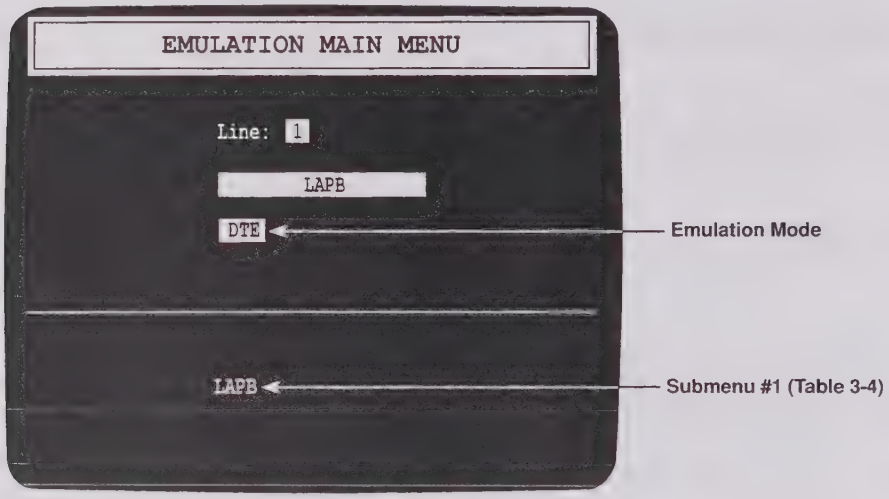
The system variable L_SAPI contains the value used in the received frame.

Script Example:

SEND PRIMITIVE 0 with MESSAGE 0	<————	Sending **SABM(E) with SAPI and TEI**
SHOW TEXT SABM SENT >>>>>>> at row 5 and column 2		
SHOW TEXT WAITING FOR UA at row 6 and column 2		
RECEIVE PRIMITIVE and don't timeout	<————	**Wait for UA**
IF VARIABLE R_PRIM = VALUE 5 GOTO L2UP	<————	**UA received WITH SAPI AND TEI**

LAPB LAPB

Emulate LAPB Only For DTE/DCE Devices



PURPOSE:

The LAPB submenu enables the emulation of a DTE or DCE using LAPB only.

TOP-LEVEL CHOICES:

Emulation Mode

DTE - Select DTE emulation

DCE - Select DCE emulation

APPLICATION SET-UP FILES:

None.

SUBMENUS:

To Set Up The:	See Table:
LAPB menu	3-2 on Page 24

NOTES:

The LAPB emulation feature permits the automatic control of Layer 1 and Layer 2, while you control Layer 3 manually via scripts. The SEND and RECEIVE primitives enable Layer 3 control.

IMPORTANT: The text immediately following assumes a thorough knowledge of script programming concepts. If you are unfamiliar with these concepts, please consult the *Scripter Reference Manual*.

LAPB LAPB

Emulate LAPB Only For DTE/DCE Devices

SEND PRIMITIVE:

Syntax:

SEND PRIMITIVE <0-3> WITH MESSAGE <number>

T_PRIM is a variable that must be set to one of the following values:

0 = causes a SABM(E) to be sent as a means of bringing up the link.

1 = causes a DISC to be sent as a means of bringing down the link.

2 = causes an INFO frame to be sent. The associated buffer is inserted in the INFO frame's data field.

3 = causes a UI frame to be sent. The associated buffer is inserted in the UI frame's data field.

RECEIVE PRIMITIVE:

Syntax:

RECEIVE PRIMITIVE and don't timeout

R_PRIM is a variable that must be set to one of the following values:

1 = indicates that a SABM(E) has been received and the link is up.

2 = indicates that a DISC has been received and the link is down.

3 = indicates that an INFO frame has been received.

4 = indicates that a UI frame has been received.

5 = confirms the receipt of a UA frame in response to the transmission of a SABM(E) and indicates that the link is up.

6 = confirms the receipt of a UA frame in response to the transmission of a DISC and indicates that the link is down.

Script Example:

SEND PRIMITIVE 0 with MESSAGE 0 <———— **Sending SABM**

SHOW TEXT SABM SENT >>>>>>> at row 5 and column 2

SHOW TEXT WAITING FOR UA at row 6 and column 2

RECEIVE PRIMITIVE and don't timeout <———— **Wait for UA**
IF VARIABLE R_PRIM = VALUE 5 GOTO L2UP <———— **UA received**

3.2 CALL CONTROL/Q.931 PROTOCOL CONTROL (LAYER3) SET-UP

The CALL CONTROL and Q.931 PROTOCOL CONTROL submenus are used to set up the Layer 3 parameters associated with ISDN telephone calls and Q.931 protocol control, respectively. These parameters must always be set when performing ISDN-D Functional emulation.

Table 3-1 lists and describes the parameters in the CALL CONTROL and Q.931 PROTOCOL CONTROL submenus.

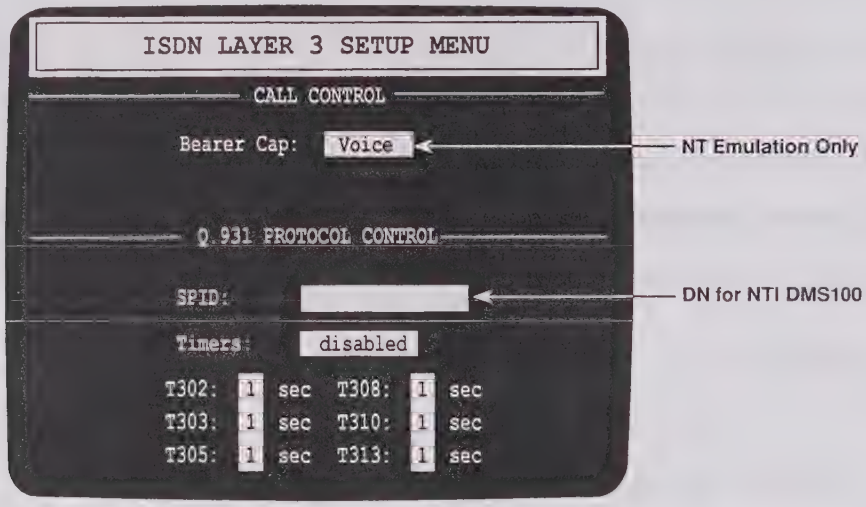


Table 3-1
Q.931/Call Control Submenus

Call Control Parameters:	**Choices:**
Bearer Cap	Voice - Select circuit-switched voice call Data - Select circuit-switched data call
Setup This parameter applies *only when NT emulation is selected.*	Broadcast - Select broadcast set-up Point-to-point - Select point-to-point set-up
Q.931 Protocol Control Parameters:	**Description:**
SPID	Enter Service Profile Identifier (SPID), to a maximum of ten ASCII characters. This parameter applies *only when the AT&T 5ESS switch-type is selected.*
DN	Enter Directory Number (DN), to a maximum of ten ASCII characters. This parameter applies *only when the NTI DMS100 switch-type is selected.*

Table 3-1
Q.931/Call Control Submenus (Continued)

Q.931 Protocol Control Parameters	Description:
Timers	Disabled - Disable all Q.931 timers Enabled - Enable all Q.931 timers Timers may be set to any value from 1 to 120 seconds in one-second increments, as follows: T302 - Set-up acknowledgement timer T303 - Set-up timer T305 - Disconnect timer T308 - Release timer T310 - Call proceeding timer T313 - Connect timer

3.3 LAPD AND MANAGEMENT ENTITY (LAYER2) SET-UP

The LAPD and MANAGEMENT ENTITY submenus are used to set up the Layer 2 parameters associated with a variety of emulation applications. These parameters must always be set when performing any of the following types of emulation:

- ISDN-D Functional
- ISDN-D Stimulus
- ISDN-D X.25 Packet
- LAPD Emulation only

Table 3-2 lists and describes the parameters in the LAPD and MANAGEMENT ENTITY submenus.

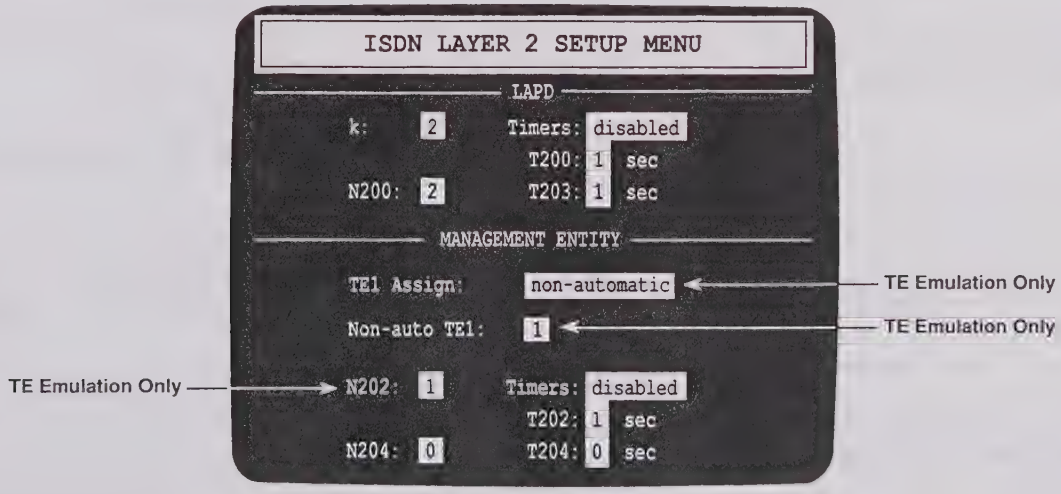


Table 3-2
LAPD/Managment Submenus

LAPD Parameters:	Description:
k	Enter the maximum number of outstanding I frames, within the range 1-127.
N200	Enter the maximum number of retransmissions, within the range 1-100.
Timers	Disabled - Disable all LAPD timers Enabled - Enable all LAPD timers Timers may be set to any value from 1 to 120 seconds in one-second increments, as follows: T200 - Acknowledgement timer T203 - Link idle timer
Management Entity Parameters:	**Description:**
TEI Assign:	automatic - Select automatic TEI assignment nonautomatic - Select nonautomatic assignment This parameter appears *only when TE emulation is selected.*
Non-auto TEI:	Enter the TEI number. This parameter appears *only when TE emulation is selected, and the TEI Assign parameter is set to nonautomatic.* The valid range is 0-63.
TEI:	Enter the TEI number. This parameter appears *only when NT emulation is selected.* The valid range is 0-126; a minimum TEI value of 64 is required when connected to an AT&T Model 7506 telephone.
N202	Enter the TEI request retransmission count. This parameter appears *only when TE emulation is selected.* The valid range is 1-100.
N204	Enter the XID retransmission count. The valid range is 1-100.
Timers	Disabled - Disable all management entity timers Enabled - Enable all management entity timers Timers may be set to any value from 1 to 120 seconds in one-second increments, as follows: T202 - TEI request timer T204 - Connection management entity timer

3.4 X.25 SET-UP

The X.25 submenu is used to set up the Layer 3 parameters associated with X.25 applications. These parameters must always be set when performing any ISDN-D X.25 Packet or X.25 emulation.

Table 3-2 lists and describes the parameters in the X.25 submenu.

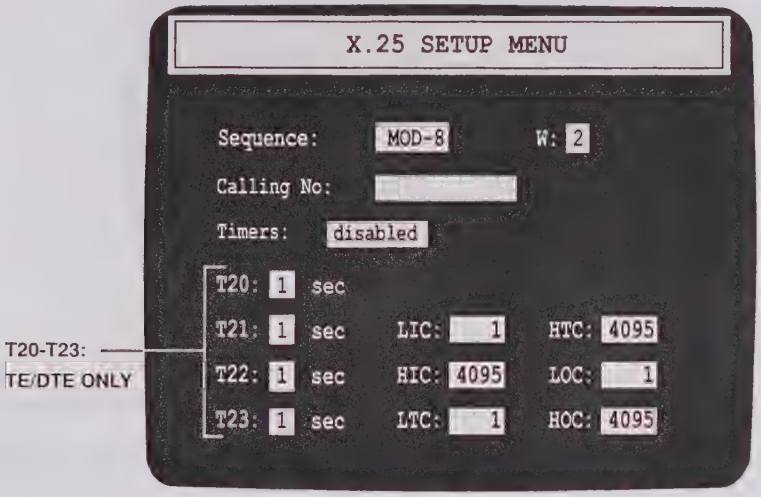


Table 3-3
The X.25 Submenu

X.25 Parameters:	Description:
Sequence	MOD-8 - Set Modulo 8 as the packet sequence number allocation scheme on Layer 3
	MOD-128 - Set Modulo 128 as the packet sequence number allocation scheme on Layer 3
W	Enter the window size for the number of outstanding frames that can be transmitted before an acknowledgement is required. The valid range is 0-127.
Calling No.	Enter the X.121 calling number (i.e., address) of your TC1000 or TC 2000 Protocol Analyzer; the CALLED number is entered at run time. The Calling No. can be any combination of ASCII characters, to a maximum of 14.
Timers	Disabled - Disable all X.25 Layer 3 timers Enabled - Enable all X.25 Layer 3 timers X.25 timers and Logical Channel Numbers (LCNs) are shown below. The valid range for all timers is 1-120; the valid range for all counters is 1-4095.

Table 3-3
The X.25 Submenu (Continued)

X.25 Parameters:	Description:
Timers (continued)	**DCE Timers:** T10 - Restart timer T11 - Incoming call timer T12 - Call clear timer T13 - Reset timer **DTE Timers:** T20 - Restart timer T21 - Call request timer T22 - Call clear timer T23 - Reset timer **LCNs:** LIC - Enter lowest incoming logical channel number HIC - Enter highest incoming logical channel number LTC - Enter lowest outgoing two-way logical channel number HTC - Enter highest outgoing two-way logical channel number LOC - Enter lowest outgoing logical channel number HOC - Enter highest outgoing logical channel number

3.5 LAPB SET-UP

The LAPB submenu is used to set up LAPB parameters. These parameters must always be set when performing X.25 or LAPB emulation.

Table 3-4 lists and describes the parameters in the LAPB submenus.

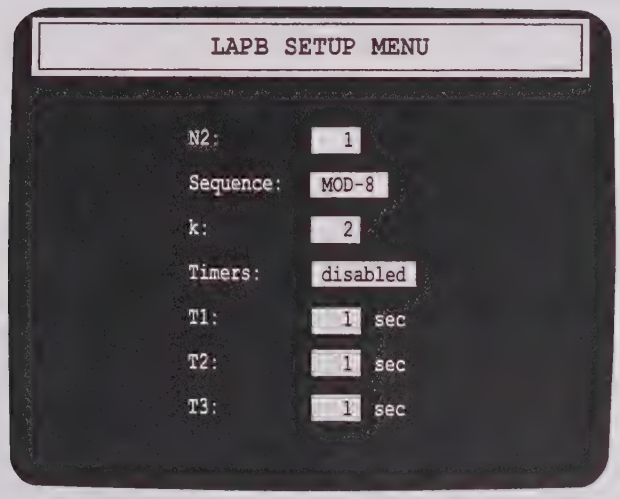


Table 3-4
LAPB Submenus

LAPB Parameters:	Description:
N2	Enter the maximum retransmission count. The valid range is 1-100.
Sequence	MOD-8 - Set Modulus 8 as the packet sequence number allocation scheme on Layer 2 MOD-128 - Set Modulus 128 as the packet sequence number allocation scheme on Layer 2
k	Enter the window size for the number of outstanding frames that can be transmitted before an acknowledgement is required. The valid range is 0-127.
Timers	Disabled - Disable all LAPB timers Enabled - Enable all LAPB timers Timers may be set to any value from 1 to 120 seconds in one-second increments, as follows: T1 - Acknowledgement timer T2 - Response timer T3 - Link idle timer

3.6 Q.931/CALL CONTROL SET-UP IN STIMULUS MODE

The CALL CONTROL and Q.931 PROTOCOL CONTROL submenus are used to set up the parameters associated with ISDN Stimulus Layer 3. These parameters must always be set when performing ISDN-D Stimulus emulation.

Table 3-5 lists and describes the parameters in the CALL CONTROL and Q.931 PROTOCOL CONTROL submenus.

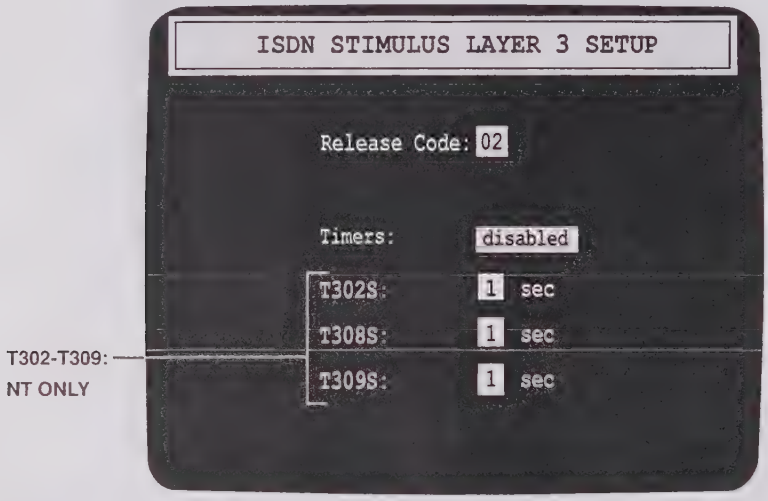


Table 3-5
The Q.931/Call Control Submenu in Stimulus Mode

Stimulus Parameters:	Description:
Release Code	Enter the release activator code (hex). The valid range is 1-40, but typical values are 2 or 18. Note that this value must match the value sent by the Meridian telephone in the Feature ID field of the FEATURE ACTIVATION I.E. when the RLS key is pressed.
Timers	Disabled - Disable all timers Enabled - Enable all timers Stimulus timers are shown below. The valid range for all timers is 1-120. NT: T302S - Initialization timer T308S - Data link failure timer T309S - Release timer TE Timers: T308S - Release timer

SECTION 4
X.25/ISDN EMULATION APPLICATIONS

4.1 SECTION SUMMARY

This section of the guide presents a series of emulation applications that are used frequently throughout the electronics industry. All such applications are offered with the menu set-ups that allow them to be performed on the TC 1000 or TC 2000 Protocol Analyzer.

4.2 APPLICATION SET-UP FILES

Each application in this section makes reference to an *application set-up file*. These files save you time by automatically recalling the menu settings that are appropriate for the peripheral device you wish to emulate. Although some menu settings vary with each application, these set-up files serve as an ideal template for your specific emulation activity. Note that these files include set-ups for both TC PROTOCOL TESTER submenus (e.g., Format, Layering, etc.) and the Emulation submenus listed below.

4.2.1 Creating an Application Set-Up File

If a set-up file for the emulation application you wish to perform is not available, you can create one as follows:

a. Set up all TC PROTOCOL TESTER submenus (Format, Layering, Interface, etc.) and Emulation submenus as desired.

b. Enter the FILE MANAGEMENT menu.

c. Within the FILE MANAGEMENT menu, select **save** from the Action submenu, and **test setups** from the Directory submenu.

d. Input a user filename (e.g., TEST100) in the Trgt File area and press the ENTER key.

RESULT: When the message **Save Completed.** is displayed on your screen, all submenu settings will be stored under the set-up filename that you specified.

4.3 X.25 EMULATION APPLICATIONS

This section of the guide describes these X.25 emulation applications:

To:	Go To Page:
Emulate an X.25 network	30
Emulate an X.25 subscriber	34

4.3.1 Emulating an X.25 Network

Figure 4-1 shows the TC1000 Protocol Analyzer emulating an X.25 network. Connection to the X.25 Packet Assembler/ Disassembler (PAD) is established using an RS-232 cable. In this configuration, you can use the Protocol Analyzer to set up a call and send the same X.25 commands and command responses that a packet-switched network would issue to a subscriber during normal operation. By monitoring command responses in various packet-level states, the Protocol Analyzer can test the PAD's ability to do all of the following:

- establish and terminate an X.25 virtual circuit
- send packetized data
- send restart, reset, and interrupt packets
- switch between data transfer state and the PAD command state

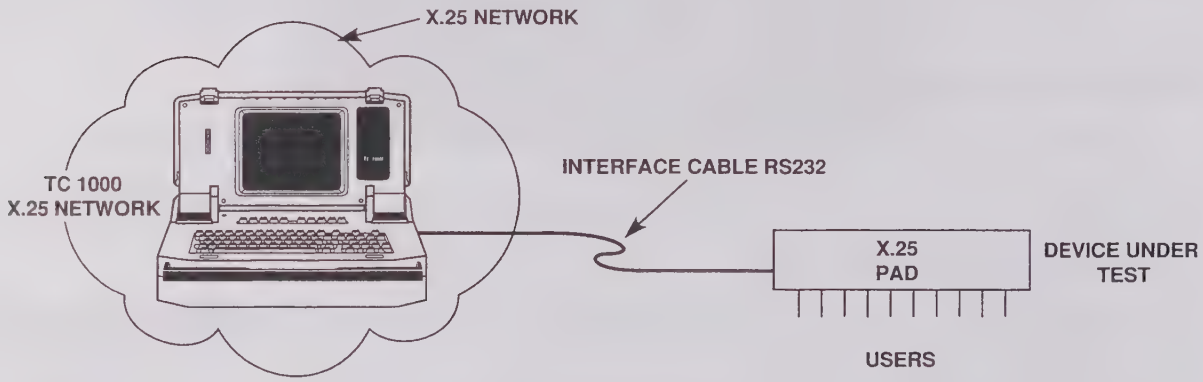


Figure 4-1
Emulating an X.25 Network

Parameter Settings:

For purposes of example only, this application assumes the setting of these parameters:

Level 1:		Level 2:		Level 3:	
Level 1 Interface	= RS-232	Level 2 Protocol	= HDLC	Level 3 Protocol	= X.25
Clock Source	= Network	Sequencing	= Modulo 8	Sequencing	= Modulo 8
Clock Speed	= 9600 bps	K (Outst. Frame)	= 2	Window Size	= 2
		T1 Timer	= 1	Calling No.	= 4087498008
		T2 Timer	= 3	T10-T13 Timers	= 4
		T3 Timer	= 20	LIC	= Same as subscriber
		N2	= 4	HIC	= Same as subscriber

Application Set-Up File:

The application file X25NET enables your Protocol Analyzer to emulate the network side of an X.25 environment. When loading this file (using the SETUP NAME submenu of the TEST OPERATIONS screen), all application submenu parameters are automatically set as shown in Figure 4-2. If any parameter does not match the requirements of your application, you can enter the correct parameter manually.

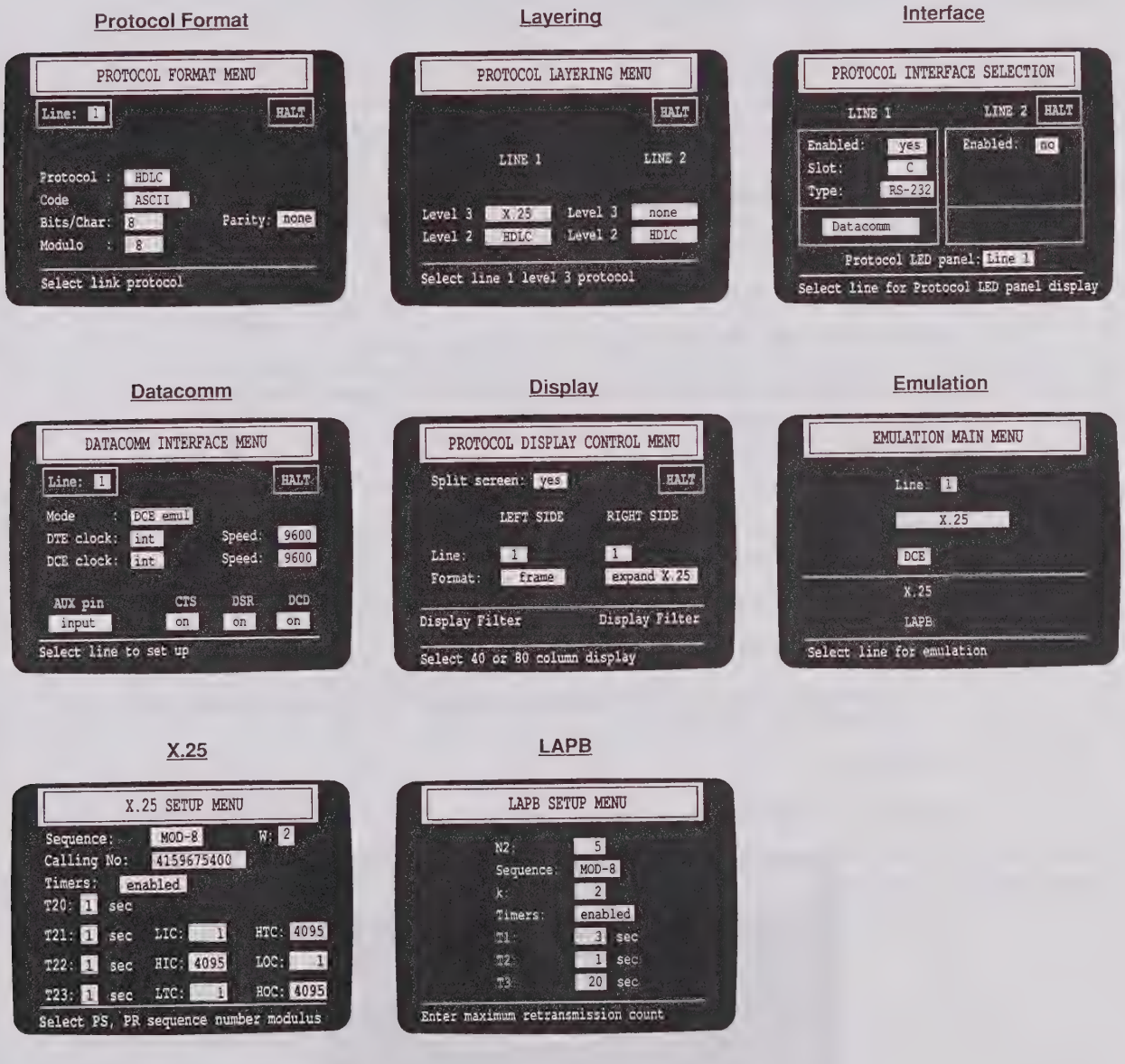


Figure 4-2
X25NET Application File — Automatic Set-Ups

X.25 Network Emulation Test Set-Up

To set up the TC1000 or TC2000 for X.25 network emulation, follow the steps listed in Table 4-1.

Table 4-1
X.25 Network Emulation Test Set-Up

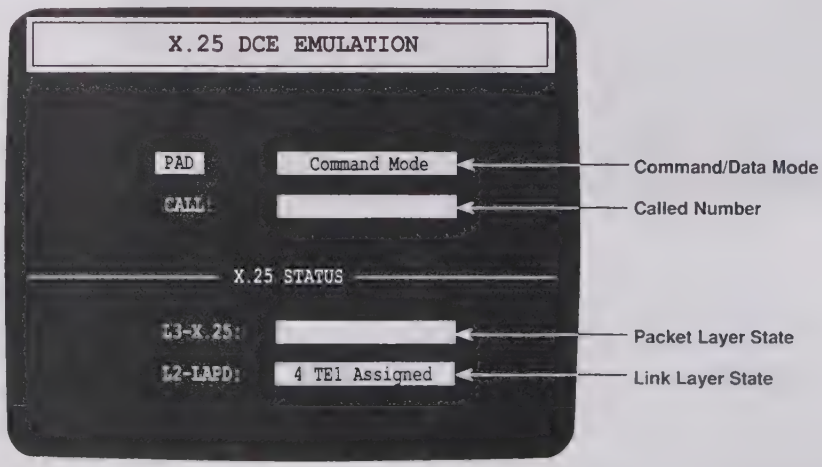
STEP	ACTIVITY
1.	Using the appropriate cables, and with power OFF, connect your Protocol Analyzer to the PAD under test as shown in Figure 4-1.
2.	After cabling, press the POWER switch to apply power to the Protocol Analyzer.
3.	When the main menu appears, Press the F4 key to select the Protocol Analyzer.
4.	When the Protocol Analzyer's main menu is displayed, press the A key to select Monitor/Emulate/Record/Playback. **RESULT**: The TEST OPERATIONS menu is displayed on your screen.
5.	Press the Right Arrow key three times; enter X25NET as the set-up file name and press the ENTER key. **RESULT**: The parameters shown in Figure 4-2 are loaded into all Test Operations and Emulation submenus.
6.	If required, change any Test Operations or Emulation submenu parameters to match the requirements of your application. **EXAMPLE**: Since calling numbers change from network-to-network, they often change from test-to-test. If required, enter the X.25 SETUP MENU and change the calling number to match the requirements of your application.
7.	After all submenu parameters have been entered correctly, do the following: a. Press the RUN/HALT key to initiate the test b. Wait for the *green* CTS, DSR, and DCD LEDs to illuminate to ensure that communication with the X.25 device has been established
8.	Press the ESC key. **RESULT**: The X.25 DCE EMULATION run-time screen is displayed. 

Table 4-1
X.25 Network Emulation Test Set-Up (Continued)

STEP	ACTIVITY
9.	Press the keys deseribed in steps a-g at any point in the test. The Protocol Analyzer monitors the packets it transmits and the packets it receives in response. During the test, note the following: X.25 run-time screens operate in two modes: • Data mode • Command mode Data mode is the mode in which you place an X.25 call. Once the call is established, you can enter command mode, where all keystrokes are packetized and sent to the Packet Assembler/Disassembler (PAD). Packets are actually sent when the ENTER key is pressed or when 20 keystrokes are packetized. **In Data Mode:** a. Press the D key to place an X.25 call. When placing a call, the DIAL field is highlighted. Key in the number you wish to call; the digits that you enter are displayed in the DIAL field. When the number has been entered correctly, press the ENTER key to send the CALL REQUST packet. When the call is established, press the ? key to switch to command mode. **In Command Mode:** b. Press H to terminate an X.25 call c. Press R to send a RESET packet d. Press S to send a RESTART packet e. Press I to send an INTERRUPT packet f. Press ENTER to forward a packet g. Press RUN/HALT to end the test h. Press ? to switch between data and command modes

4.3.2 Emulating an X.25 Subscriber

Figure 4-3 shows the TC1000 Protocol Analyzer emulating an X.25 subscriber. Connection to an X.25 packet-switched network is established using an RS-232 cable. In this configuration, you can use the Protocol Analyzer to set up a call and send the same X.25 commands that a subscriber would issue to the network. By monitoring command responses in various packet-level states, the Protocol Analyzer can test the subscriber's ability to do all of the following:

- set up a call and communicate with the X.25 network
- respond to packetized data sent from the network
- send packetized data to the network
- switch between data transfer state and the PAD command state
- send restart, reset, and interrupt packets

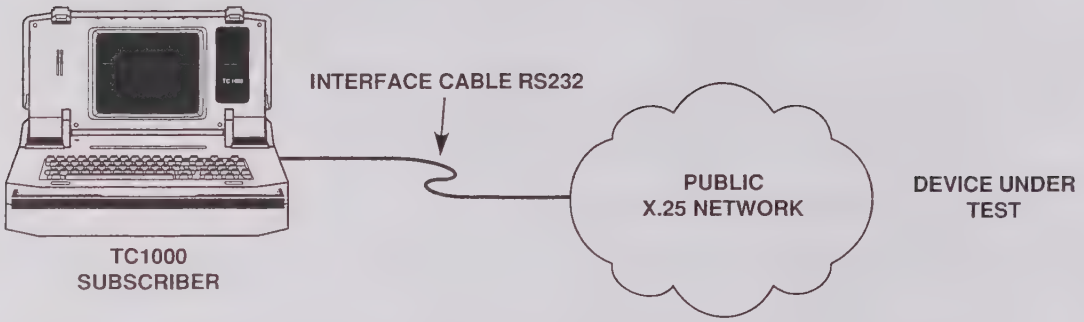


Figure 4-3
Emulating an X.25 Subscriber

Parameter Settings:

For purposes of example only, this application assumes the setting of these parameters:

Level 1:

Level 1 Interface	=	RS-232
Clock Source	=	Network
Clock Speed	=	9600 bps

Level 2:

Level 2 Protocol	=	HDLC
Sequencing	=	Modulo 8
k (Outst. Frame)	=	2
T1 Timer	=	1
T2 Timer	=	3
T3 Timer	=	20
N2 Timer	=	4

Level 3:

Level 3 Protocol	=	X.25
Sequencing	=	Modulo 8
Window Size	=	2
Calling No.	=	4087498008
T20-23 Timers	=	4
LIC	=	1
HIC	=	4095
LTC	=	1
HTC	=	4095
LOC	=	1
HOC	=	4095

Application Set-Up File:

The application file X25SUB enables your Protocol Analyzer to emulate the subscriber side of an X.25 environment. When loading this file (using the SETUP NAME submenu of the TEST OPERATIONS screen), all application submenu parameters are automatically set as shown in Figure 4-4. If any parameter does not match the requirements of your application, you can enter the correct parameter manually.

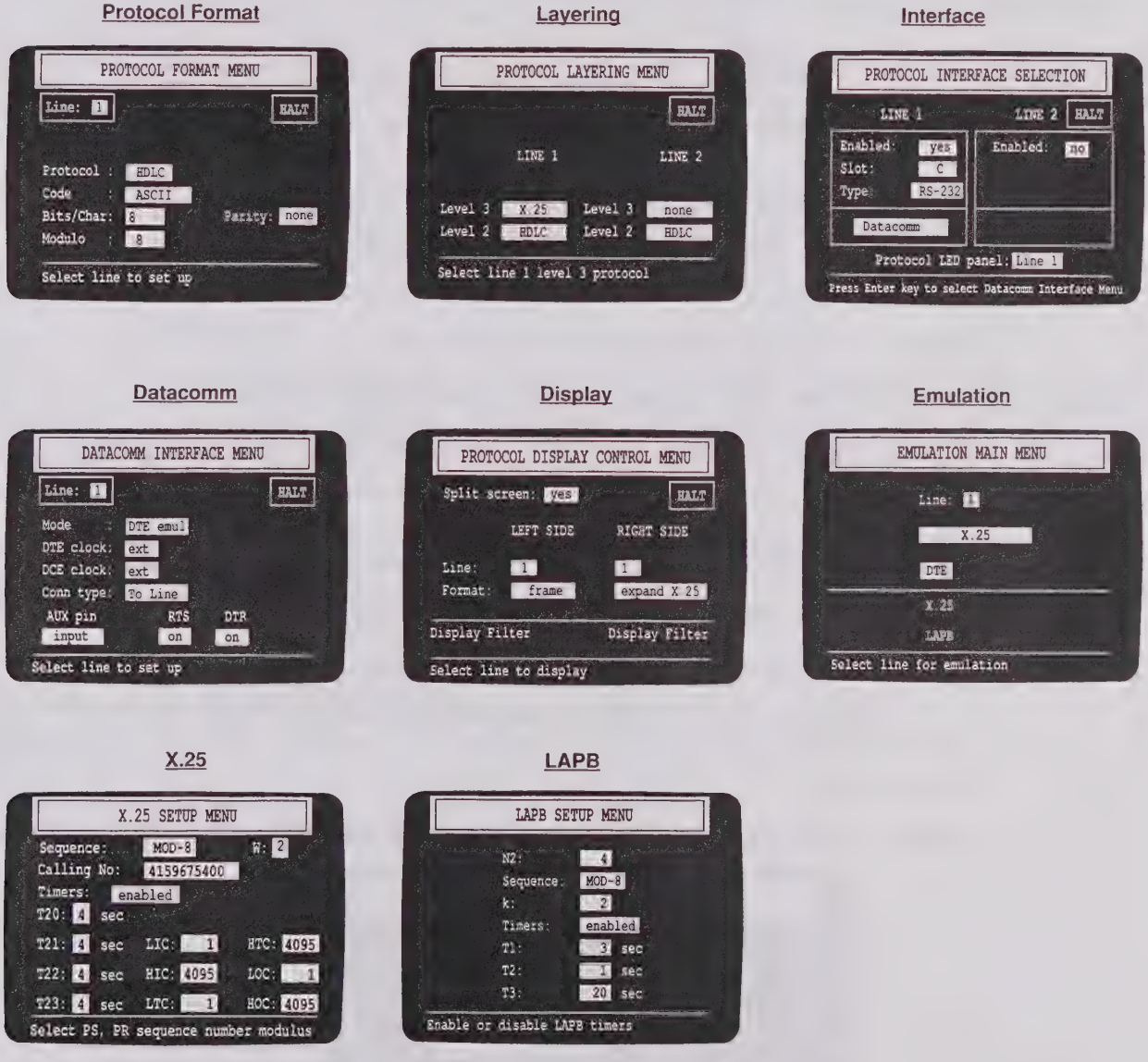


Figure 4-4
X25SUB Application File — Automatic Set-Ups

X.25 Subscriber Emulation Test Set-Up

To set up the TC1000 or TC2000 for X.25 subscriber emulation, follow the steps listed in Table 4-2.

Table 4-2
X.25 Subscriber Emulation Test Set-Up

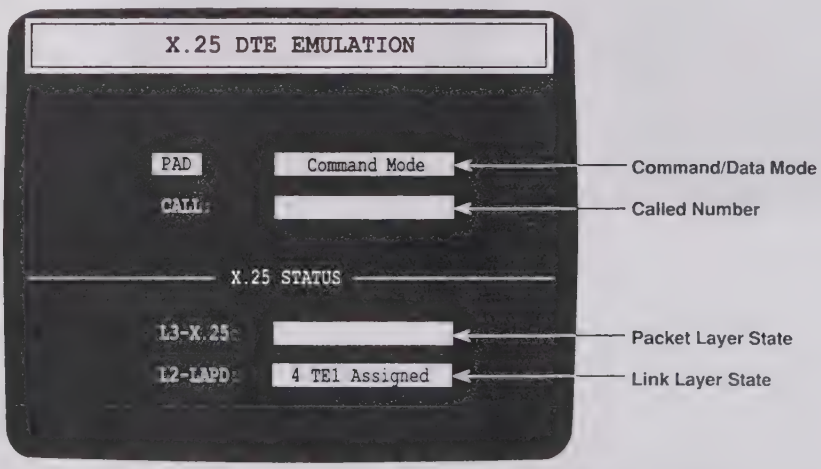
STEP	ACTIVITY
1.	Using the appropriate cables, and with power OFF, connect your Protocol Analyzer to the X.25 network as shown in Figure 4-3.
2.	After cabling, press the POWER switch to apply power to the Protocol Analyzer.
3.	When the main menu appears, Press the F4 key to select the Protocol Analyzer.
4.	When the Protocol Analzyer's main menu is displayed, press the A key to select Monitor/Emulate/Record/Playback. **RESULT**: The TEST OPERATIONS menu is displayed on your screen.
5.	Press the Right Arrow key three times; enter X25SUB as the set-up file name and press the ENTER key. **RESULT**: The parameters shown in Figure 4-4 are loaded into all Test Operations and Emulation submenus.
6.	If required, change any Test Operations or Emulation submenu parameters to match the requirements of your application. **EXAMPLE**: Since calling numbers change from network-to-network, they often change from test-to-test. If required, enter the X.25 SETUP MENU and change the calling number to match the requirements of your application.
7.	After all submenu parameters have been entered correctly, do the following: a. Press the RUN/HALT key to initiate the test b. Wait for the *green* RTS and DTR LEDs to illuminate to ensure that communication with the X.25 network has been established
8.	Press the ESC key. **RESULT**: The X.25 DTE EMULATION run-time screen is displayed. 

Table 4-2
X.25 Subscriber Emulation Test Set-Up (Continued)

STEP	ACTIVITY
9.	Press the keys deseribed in steps a-g at any point in the test. The Protocol Analyzer monitors the packets it transmits and the packets it receives in response. During the test, note the following: X.25 run-time screens operate in two modes: • Data mode • Command mode Data mode is the mode in which you place an X.25 call. Once the call is established, you can enter command mode, where all keystrokes are packetized and sent to the Packet Assembler/Disassembler (PAD). Packets are actually sent when the ENTER key is pressed or when 20 keystrokes are packetized. **In Data Mode:** a. Press the D key to place an X.25 call. When placing a call, the DIAL field is highlighted. Key in the number you wish to call; the digits that you enter are displayed in the DIAL field. When the number has been entered correctly, press the ENTER key to send the CALL REQUST packet. When the call is established, press the ? key to switch to command mode. **In Command Mode:** b. Press H to terminate an X.25 call c. Press R to send a RESET packet d. Press S to send a RESTART packet e. Press I to send an INTERRUPT packet f. Press ENTER to forward a packet g. Press RUN/HALT to end the test h. Press ? to switch between data and command modes

4.4 ISDN EMULATION APPLICATIONS

This section of the guide describes these ISDN emulation applications:

To:	Go To Page:
Emulate an AT&T network (NT) in Functional mode	38
Emulate a Northern Telecom DMS-100 network in Functional mode	41
Emulate a Northern Telecom DMS-100 network in Stimulus mode	45
Emulate an AT&T telephone in Functional mode	48
Emulate a Northern Telecom DMS-100 network in Functional mode	52
Emulate a Northern Telecom DMS-100 network in Stimulus mode	55

4.4.1 Emulating an AT&T Network in Functional Mode

Figure 4-5 shows the TC1000 Protocol Analyzer emulating an AT&T network. Connection to an AT&T 7506, Fujitsu SRS-2000, or compatible ISDN telephone is established using RJ45 connectors on the S bus. In this configuration, you can use the Protocol Analyzer to emulate the NT side of a Basic Rate Interface (BRI) in functional mode, and test conformance to Layer 2 and Layer 3 ISDN protocol standards by doing any or all of the following:

- initating or accepting a call (call set-up)
- terminating (i.e., "hanging-up") a voice call (call tear-down)
- sending a Service Profile Identification (SPID) request
- sending an Endpoint Service Message (EPSM)
- sending a Call Reference Value (CRV) audit
- sending a Terminal Endpoint Identifier (TEI) audit

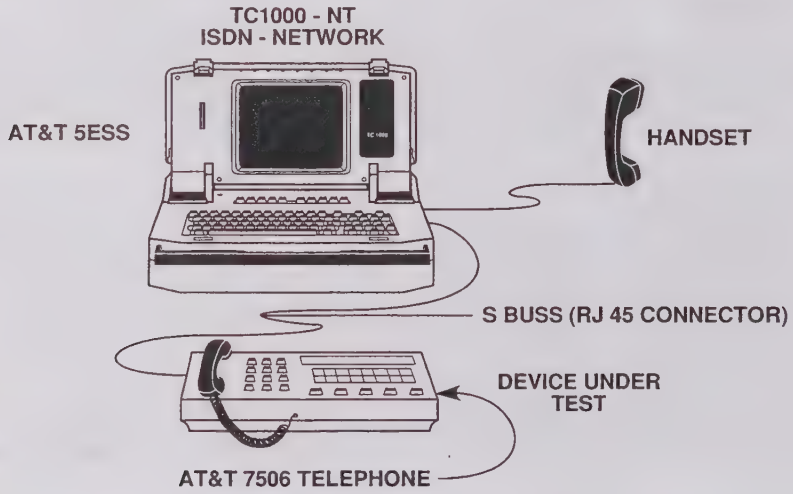


Figure 4-5
Emulating an AT&T Network in Functional Mode

Parameter Settings:

For purposes of example only, this application assumes the setting of these parameters:

Level 1:			Level 2:			Level 3:		
Level 1 Interface	=	Basic Rate	Level 2 Protocol	=	LAPD	Level 3 Protocol	=	Q.931
Line Termination	=	100 Ohms	Sig. Channel	=	D	Switch Type	=	AT&T 5ESS
Clock Speed	=	192 kb/s	Sequencing	=	Modulo 128	B-Chan. Function	=	Voice
Emulation	=	NT	k	=	2	SPID	=	4159675400
Power Source	=	PS1	T200 Timer	=	1			
Loop	=	Off	T203 Timer	=	20			
			N200	=	5			
			N204	=	1			
			TEI Address	=	64			

Application Set-Up File:

The application file NTATT enables your Protocol Analyzer to emulate an AT&T network in Functional mode. When loading this file (using the SETUP NAME submenu of the TEST OPERATIONS screen), all application submenu parameters are automatically set as shown in Figure 4-6. If any parameter does not match the requirements of your application, you can enter the correct parameter manually.

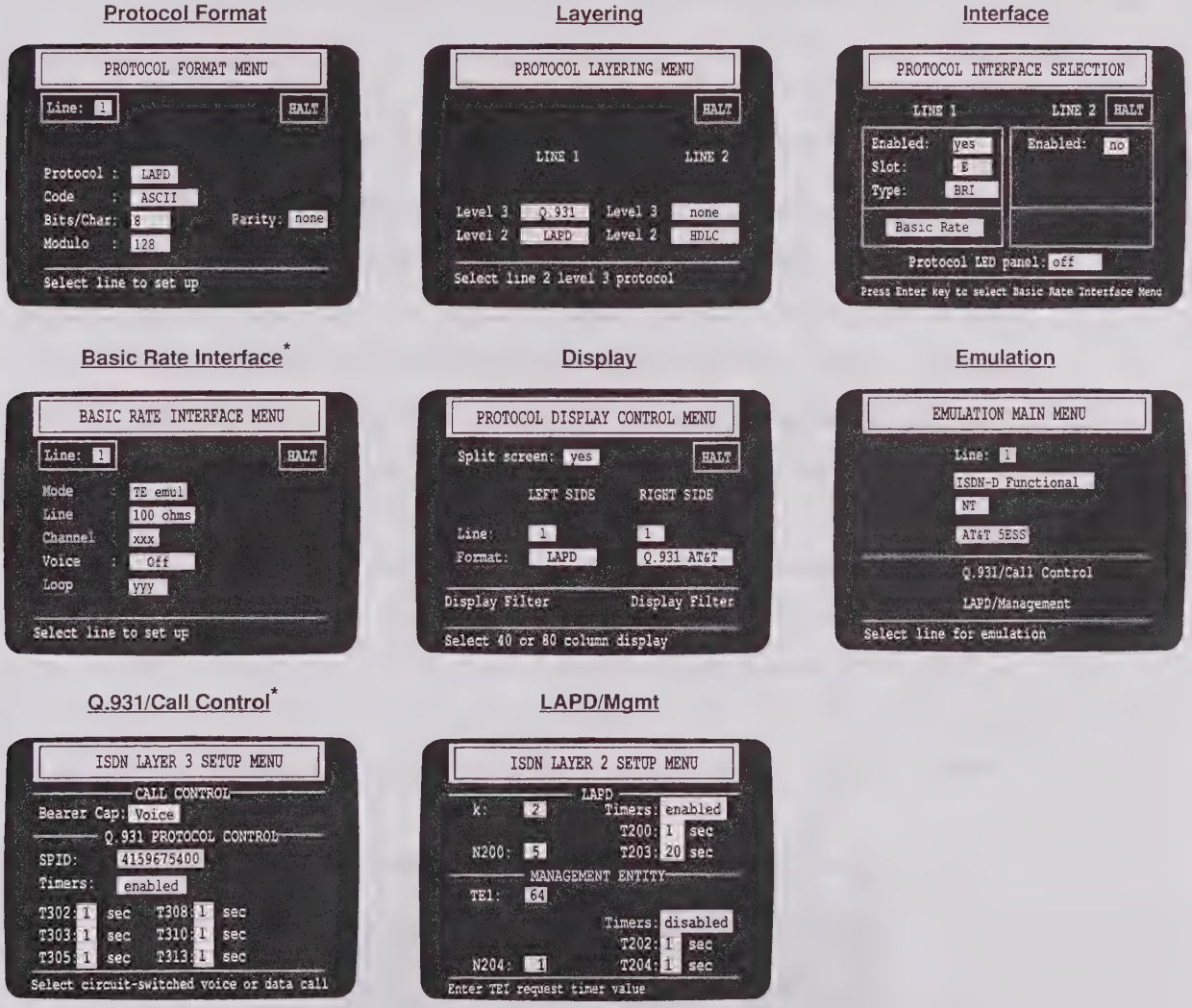


Figure 4-6
NTATT Application File — Automatic Set-Ups

*NOTEs on Bearer Channel Selection

If the bearer capability is set to voice in the CALL CONTROL menu, then the bearer channel sent in the SETUP message is derived from the Voice channel specified (see yyy) in the BASIC RATE INTERFACE menu.

If the bearer capability is set to data in the CALL CONTROL menu, then the bearer channel sent in the SETUP message is derived from the Channel field specified (see XXX) for the other line in the BRI menu. For example, if you emulate the D channel on Line 2, then the Line 1 channel (B1 or B2) is used in the bearer capability IE.

AT&T Network Emulation Test Set-Up (Functional Mode)

To set up the TC1000 or TC2000 for AT&T network emulation in Functional Mode, follow the steps listed in Table 4-3.

Table 4-3
AT&T Network Emulation Test Set-Up (Functional Mode)

STEP	ACTIVITY
1.	Using the appropriate cables, and with power OFF, connect your Protocol Analyzer to the ISDN telephone as shown in Figure 4-5.
2.	After cabling, press the POWER switch to apply power to the Protocol Analyzer.
3.	When the main menu appears, Press the F4 key to select the Protocol Analyzer.
4.	When the Protocol Analzyer's main menu is displayed, press the A key to select Monitor/Emulate/Record/Playback. **RESULT**: The TEST OPERATIONS menu is displayed on your screen.
5.	Press the Right Arrow key three times; enter NTATT as the set-up file name and press the ENTER key. **RESULT**: The parameters shown in Figure 4-6 are loaded into all Test Operations and Emulation submenus.
6.	If required, change any Test Operations or Emulation submenu parameters to match the requirements of your application.
7.	After all submenu parameters have been entered correctly, do the following: a. Press the RUN/HALT key to initiate the test b. Wait for SYNC to appear in the STATUS menu
8.	Press the ESC key. **RESULT**: The ISDN BASIC RATE NETWORK EMULATION run-time screen is displayed.

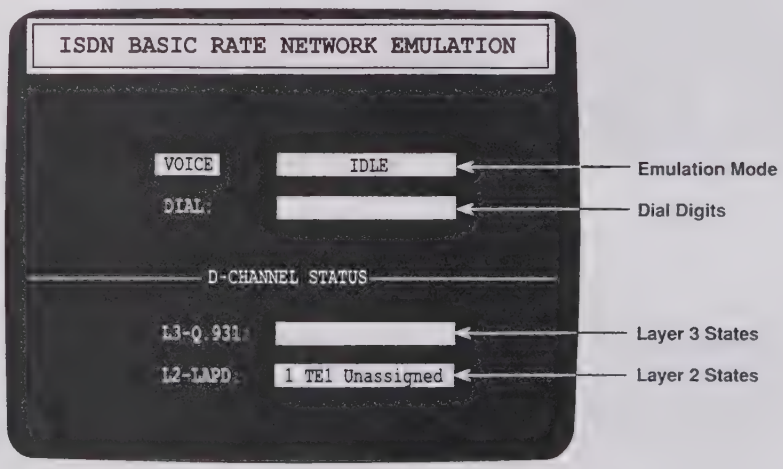


Table 4-3
AT&T Network Emulation Set-Up (Functional Mode — Continued)

STEP	ACTIVITY
9.	Press any of these keys during the test. The Protcol Analyzer monitors both the data it transmits and the data in receives in response. a. V to place or accept a call b. H to terminate a call c. S to send a SPID request (does not apply to 5E4 software release) d. E to send a EPSM request (does not apply to 5E4 software release) e. X to send a CRV audit (does not apply to 5E4 software release) f. A to send a TEI audit g. RUN/HALT to end the test h. HELP key to list all options

4.4.2 Emulating an Northern Telecom Network in Functional Mode

Figure 4-7 shows the TC1000 Protocol Analyzer emulating a Northern Telecom network. Connection to a Northern Telecom Meridian ISDN telephone is established using RJ45 connectors on the S buss. In this configuration, you can use the Protocol Analyzer to emulate the NT side of a Basic Rate Interface (BRI) in functional mode, and test conformance to Layer 2 and Layer 3 ISDN protocol standards by doing any or all of the following:

- initating or accepting a call (call set-up)
- terminating (i.e., "hanging-up") a voice call (call tear-down)
- sending a TEI audit

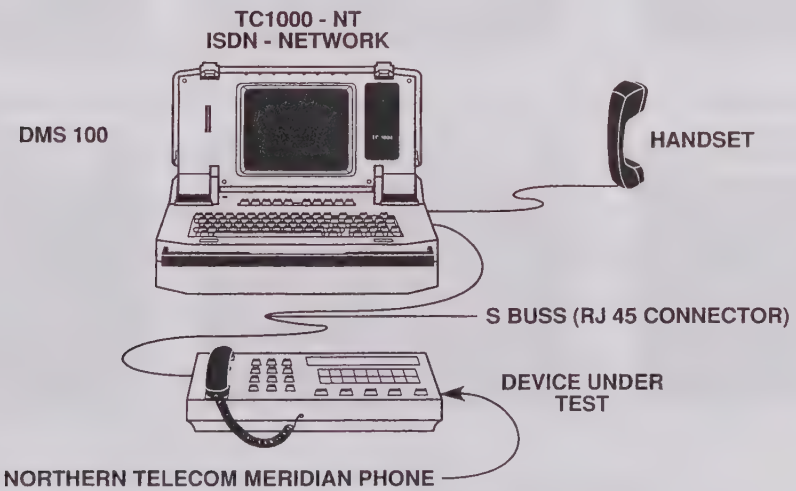


Figure 4-7
Emulating a Northern Telecom Network in Functional Mode

Parameter Settings:

For purposes of example only, this application assumes the setting of these parameters:

Level 1:

Level 1 Interface	=	Basic Rate
Line Termination	=	100 Ohms
Clock Speed	=	192 kb/s
Emulation	=	NT
Power Source	=	PS1
Loop	=	Off

Level 2:

Level 2 Protocol	=	LAPD
Sig. Channel	=	D
Sequencing	=	Modulo 128
k	=	2
T200 Timer	=	1
T203 Timer	=	20
N200	=	5
N204	=	1
TEI Address	=	01

Level 3:

Level 3 Protocol	=	Q.931
DN	=	4444
Level 3 Switch	=	NTI DMS 100
B-Chan. Function	=	Voice

Application Set-Up File:

The application file NTNTF enables your Protocol Analyzer to emulate a Northern Telecom network in Functional mode. When loading this file (using the SETUP NAME submenu of the TEST OPERATIONS screen), all application submenu parameters are automatically set as shown in Figure 4-8. If any parameter does not match the requirements of your application, you can enter the correct parameter manually.

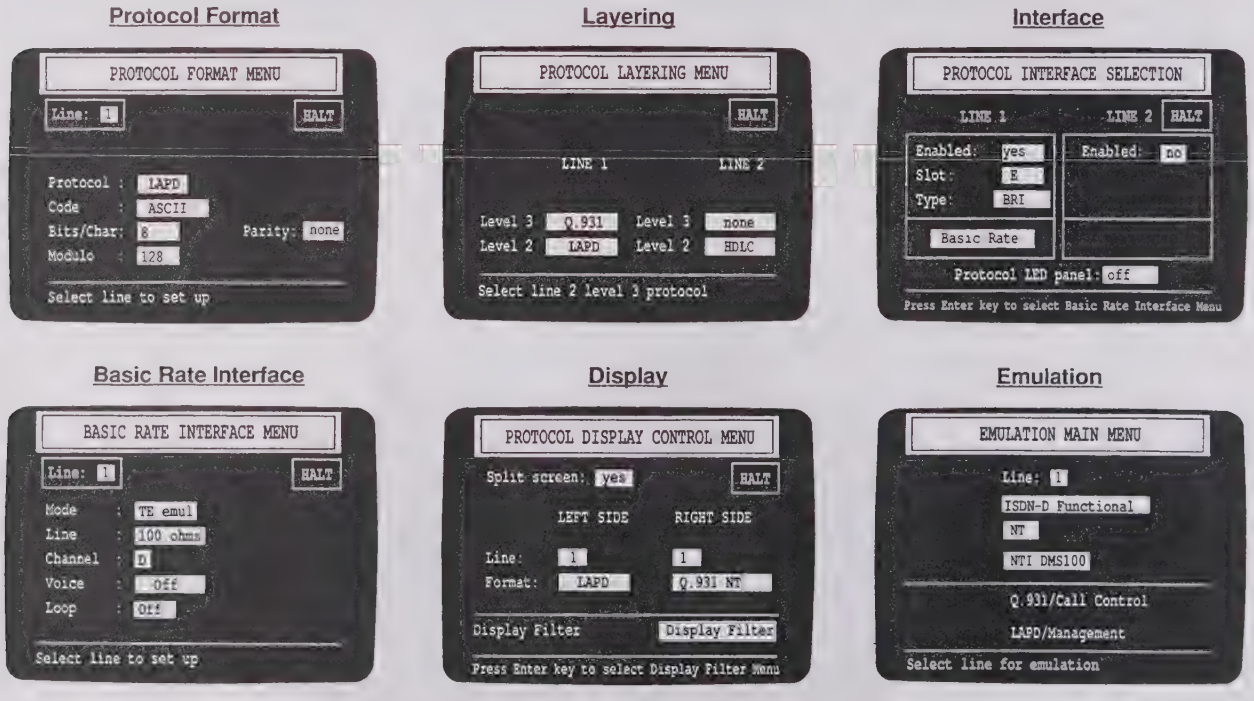
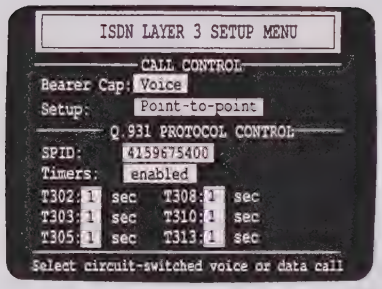


Figure 4-8
NTNTF Application File — Automatic Set-Ups

Q.931/Call Control



LAPD/Mgmt

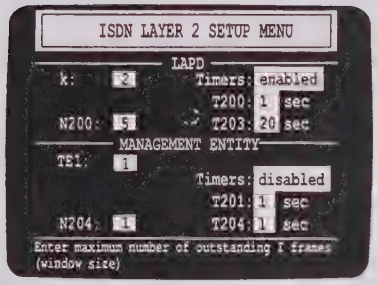


Figure 4-8
NTNTF Application File — Automatic Set-Ups (Continued)

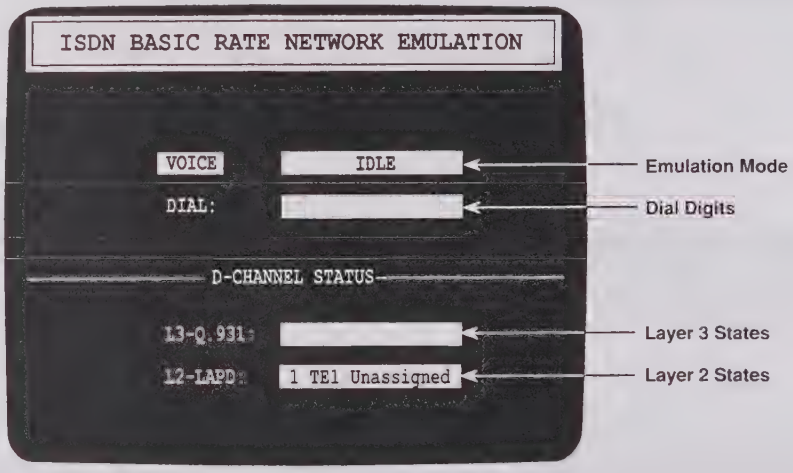
Northern Telecom Network Emulation Test Set-Up (Functional Mode)

To set up the TC1000 or TC2000 for Northern Telecom network emulation in Functional mode, follow the steps listed in Table 4-4.

Table 4-4
Northern Telecom Network Emulation Test Set-Up (Functional Mode)

STEP	ACTIVITY
1.	Using the appropriate cables, and with power OFF, connect your Protocol Analyzer to the ISDN telephone as shown in Figure 4-7.
2.	After cabling, press the POWER switch to apply power to the Protocol Analyzer.
3.	When the main menu appears, Press the F4 key to select the Protocol Analyzer.
4.	When the Protocol Analzyer's main menu is displayed, press the A key to select Monitor/Emulate/Record/Playback. **RESULT**: The TEST OPERATIONS menu is displayed on your screen.
5.	Press the Right Arrow key three times; enter NTNTF as the set-up file name and press the ENTER key. **RESULT**: The parameters shown in Figure 4-8 are loaded into all Test Operations and Emulation submenus.
6.	If required, change any Test Operations or Emulation submenu parameters to match the requirements of your application.
7.	After all submenu parameters have been entered correctly, do the following: a. Press the RUN/HALT key to initiate the test b. Wait for SYNC to appear in the STATUS menu

Table 4-4
Northern Telecom Network Emulation Set-Up (Functional Mode — Continued)

STEP	ACTIVITY
8.	Press the ESC key. **RESULT**: The ISDN BASIC RATE EMULATION run-time screen is displayed. 
9.	Press any of these keys during the test. The Protocol Analyzer monitors both the data it transmits and the data it receives in response. a. V to initiate or accept a call b. H to terminate a voice call c. A to send a TEI audit

4.4.3 Emulating a Northern Telecom Network in Stimulus Mode

Figure 4-9 shows the TC1000 Protocol Analyzer emulating a Northern Telecom network. Connection to a Northern Telecom Meridian ISDN telephone is established using RJ45 connectors on the S bus. In this configuration, you can use the Protocol Analyzer to emulate the NT side of a Basic Rate Interface (BRI) in stimulus mode, and test conformance to Layer 2 and Layer 3 ISDN protocol standards by doing any or all of the following:

- initating or accepting a call (call set-up)
- terminating (i.e., "hanging-up") a voice call (call tear-down)
- sending a TEI audit

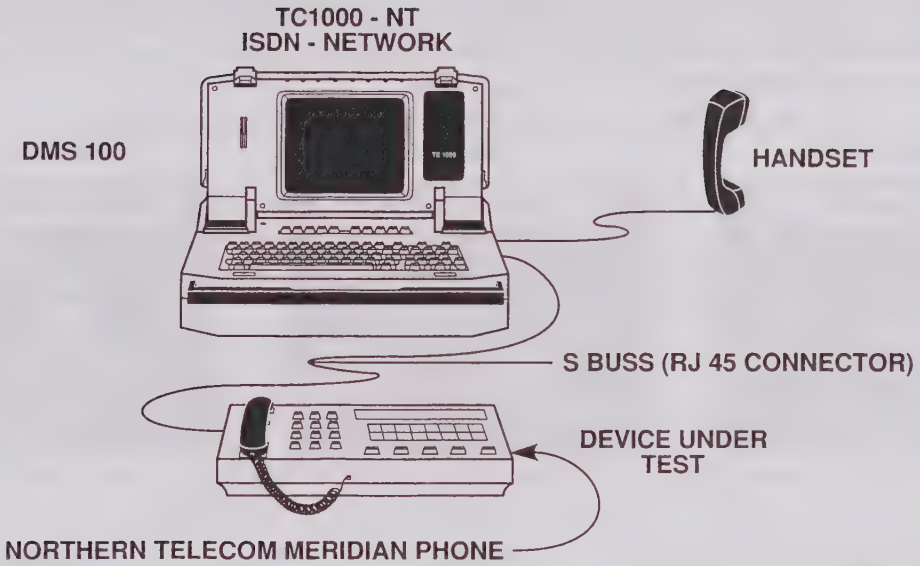


Figure 4-9
Emulating a Northern Telecom Network in Stimulus Mode

Parameter Settings:

For purposes of example only, this application assumes the setting of these parameters:

Level 1:			Level 2:			Level 3:		
Level 1 Interface	=	Basic Rate	Level 2 Protocol	=	LAPD	Level 3 Protocol	=	Q.931
Line Loading	=	100 Ohms	Sig. Channel	=	D	Release Code	=	02 or 18
Clock Speed	=	192 kb/s	Sequencing	=	Modulo 128			
Emulation	=	NT	k	=	2			
			T200 Timer	=	1			
			T203 Timer	=	20			
			N200 Timer	=	5			
			N204 Timer	=	1			
			TEI Address	=	01			

Application Set-Up File:

The application file NTNTS enables your Protocol Analyzer to emulate a Northern Telecom network in Stimulus mode. When loading this file (using the SETUP NAME submenu of the TEST OPERATIONS screen), all application submenu parameters are automatically set as shown in Figure 4-10. If any parameter does not match the requirements of your application, you can enter the correct parameter manually.

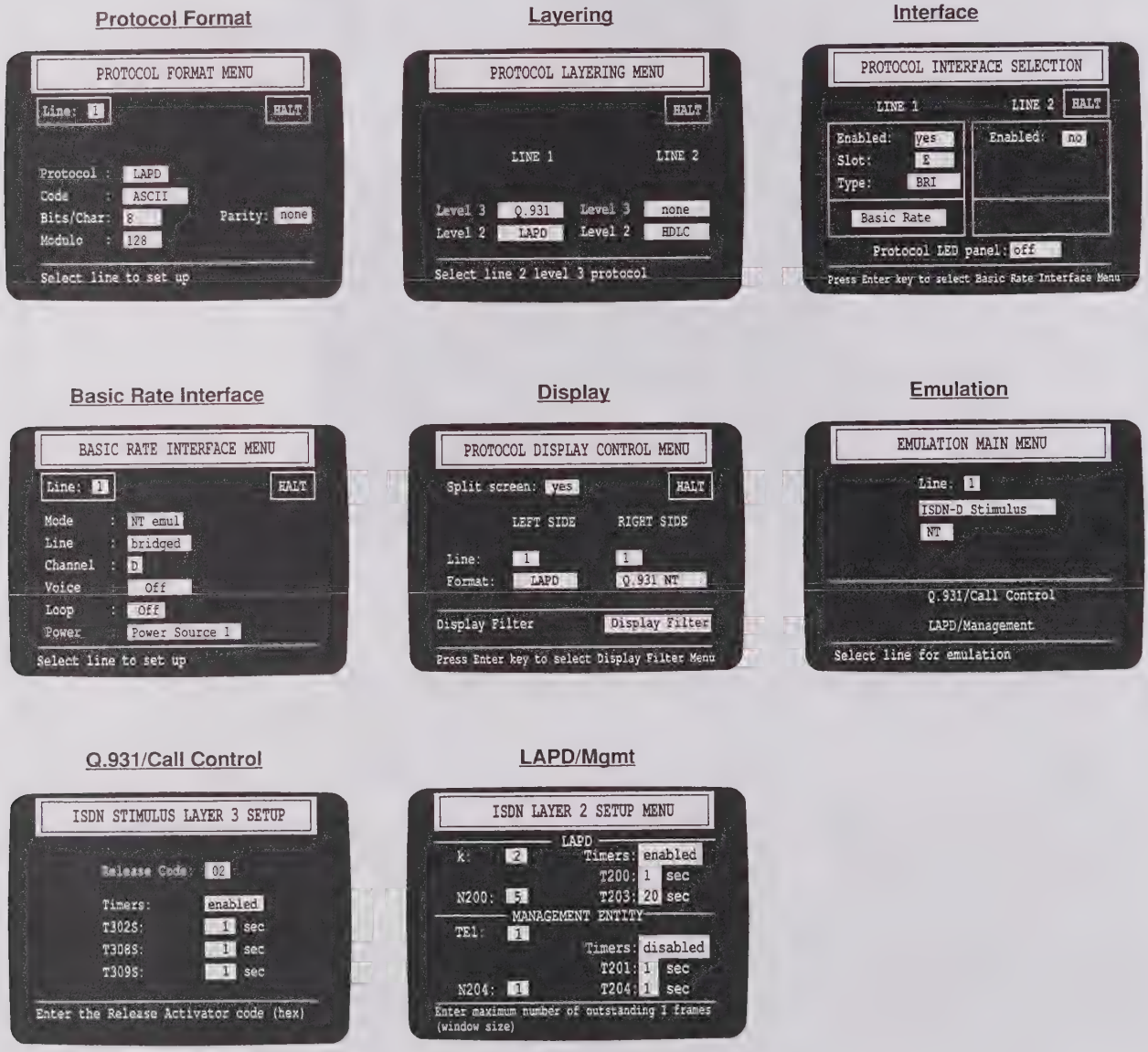


Figure 4-10
NTNTS Application File — Automatic Set-Ups

Northern Telecom Network Emulation Test Set-Up (Stimulus Mode)

To set up the TC1000 or TC2000 for Northern Telecom network emulation in Stimulus mode, follow the steps listed in Table 4-5.

Table 4-5
Northern Telecom Network Emulation Test Set-Up (Stimulus Mode)

STEP	ACTIVITY
1.	Using the appropriate cables, and with power OFF, connect your Protocol Analyzer to the ISDN telephone as shown in Figure 4-9.
2.	After cabling, press the POWER switch to apply power to the Protocol Analyzer.
3.	When the main menu appears, Press the F4 key to select the Protocol Analyzer.
4.	When the Protocol Analzyer's main menu is displayed, press the A key to select Monitor/Eumulate/record/Playback. **RESULT:** The TEST OPERATIONS menu is displayed on your screen.
5.	Press the Right Arrow key three times; enter NTNTS as the set-up file name and press the ENTER key. **RESULT:** The parameters shown in Figure 4-10 are loaded into all Test Operations and Emulation submenus.
6.	If required, change any Test Operations or Emulation submenu parameters to match the requirements of your application.
7.	After all submenu parameters have been entered correctly, do the following: a. Press the RUN/HALT key to initiate the test b. Wait for SYNC to appear in the STATUS menu
8.	Press the ESC key. **RESULT:** The ISDN BASIC RATE NETWORK EMULATION run-time screen is displayed.

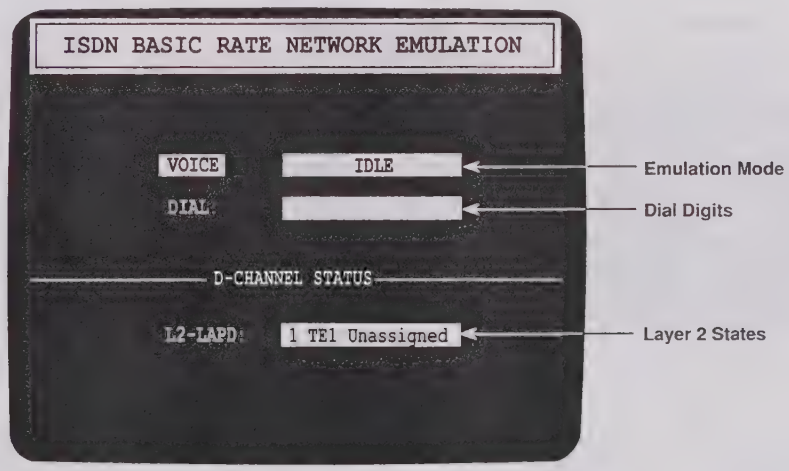


Table 4-5
Northern Telecom Network Emulation Set-Up (Stimulus Mode — Continued)

STEP	ACTIVITY
9.	Press any of these keys during the test. The Protocol Analyzer monitors both the data it transmits and the data it receives in response. a. V to initiate or accept a call b. H to terminate a voice call c. I to send an initialized IE d. A to send a TEI audit

4.4.4 Emulating an AT&T Telephone in Functional Mode

Figure 4-11 shows the TC1000 Protocol Analyzer emulating an AT&T ISDN telephone. Connection to the AT&T network NT is established using RJ45 connectors on the S Buss. In this configuration, you can use the Protocol Analyzer to emulate the TE side of a Basic Rate Interface (BRI) in functional mode, and test conformance to Layer 2 and Layer 3 ISDN protocol standards by doing any or all of the following:

- initating or accepting a call (call set-up)
- terminating (i.e., "hanging-up") a voice call (call tear-down)
- sending a SPID request
- sending an EPSM
- sending a CRV audit
- sending a TEI audit

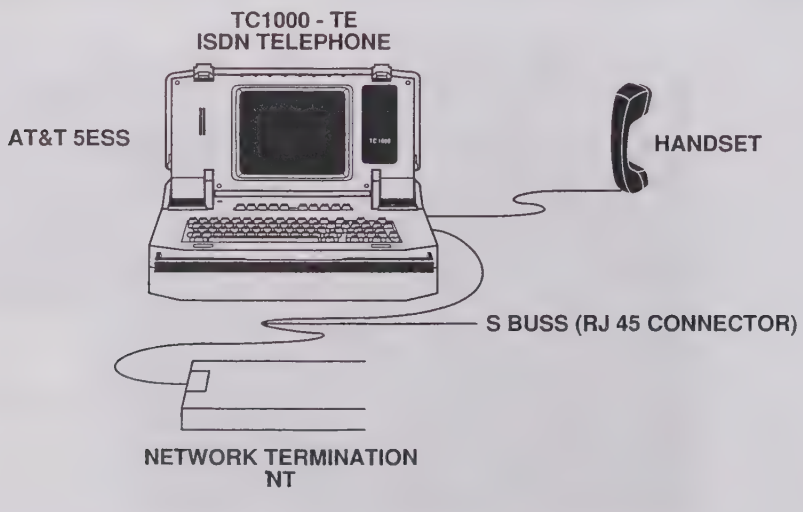


Figure 4-11
Emulating an AT&T Telephone in Functional Mode

Parameter Settings:

For purposes of example only, this application assumes the setting of these parameters:

Level 1:

Level 1 Interface	=	Basic Rate
Line Loading	=	100 Ohms
Clock Speed	=	192 kb/s
Emulation	=	TE

Level 2:

Level 2 Protocol	=	LAPD
Sig. Channel	=	D
Sequencing	=	Modulo 128
k	=	2
T200 Timer	=	1
T203 Timer	=	20
N200 Timer	=	5
N204 Timer	=	1
TEI Address	=	Automatic

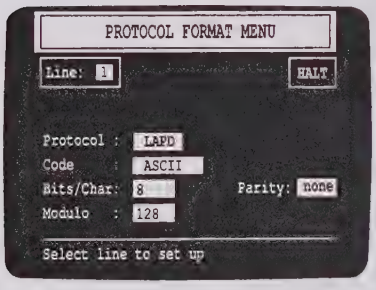
Level 3:

Level 3 Protocol	=	Q.931
Level 3 Switch	=	AT&T 5ESS
B-Chan. Function	=	Voice
SPID	=	4159675400

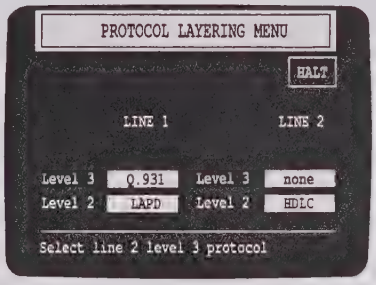
Application Set-Up File:

The application file TEATT enables your Protocol Analyzer to emulate an AT&T telephone in Functional mode. When loading this file (using the SETUP NAME submenu of the TEST OPERATIONS screen), all application submenu parameters are automatically set as shown in Figure 4-12. If any parameter does not match the requirements of your application, you can enter the correct parameter manually.

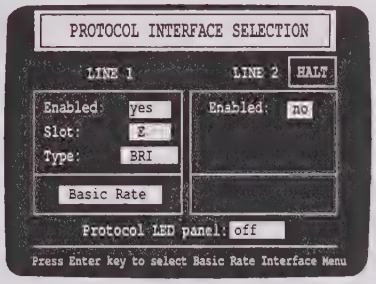
Protocol Format



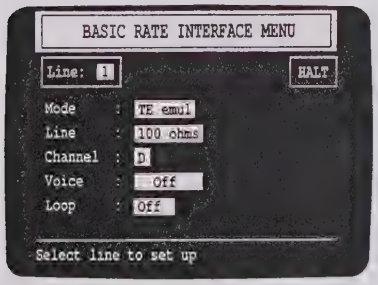
Layering



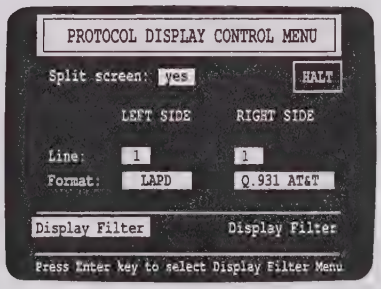
Interface



Basic Rate Interface



Display



Emulation

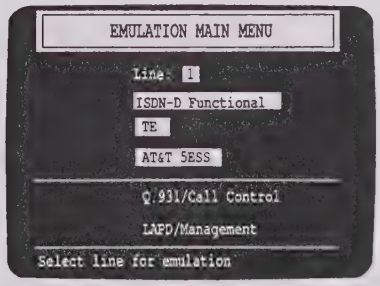
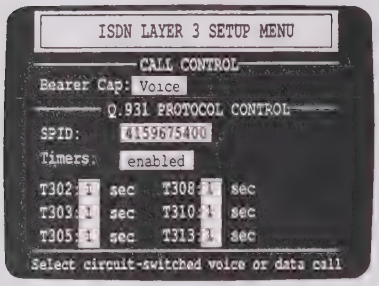


Figure 4-12
TEATT Application File — Automatic Set-Ups

Q.931/Call Control


ISDN LAYER 3 SETUP MENU
CALL CONTROL
Bearer Cap: Voice
Q.931 PROTOCOL CONTROL
SPID: 4159675400
Timers: enabled
T302: 1 sec T308: 1 sec
T303: 1 sec T310: 1 sec
T305: 1 sec T313: 1 sec
Select circuit-switched voice or data call

LAPD/Mgmt

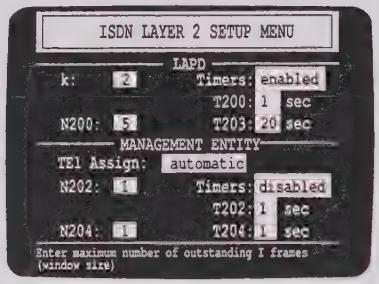

ISDN LAYER 2 SETUP MENU
LAPD
k: 2 Timers: enabled
T200: 1 sec
N200: 5 T203: 20 sec
MANAGEMENT ENTITY
TEI Assign: automatic
N202: 1 Timers: disabled
T202: 1 sec
N204: 1 T204: 1 sec
Enter maximum number of outstanding I frames (window size)

Figure 4-12
TEATT Application File — Automatic Set-Ups (Continued)

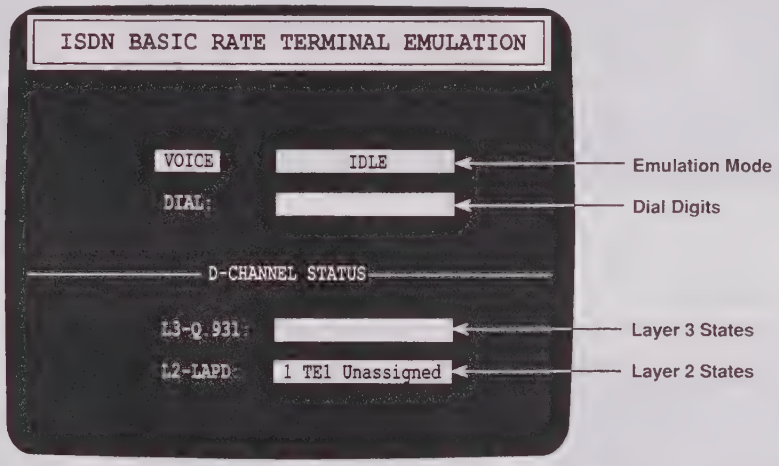
AT&T Telephone Emulation Test Set-up (Functional Mode)

To set up the TC1000 or TC2000 for AT&T telephone emulation in Functional Mode, follow the steps listed in Table 4-6.

Table 4-6
AT&T Telephone Emulation Test Set-Up (Functional Mode)

STEP	ACTIVITY
1.	Using the appropriate cables, and with power OFF, connect your Protocol Analyzer to the ISDN network as shown in Figure 4-11.
2.	After cabling, press the POWER switch to apply power to the Protocol Analyzer.
3.	When the main menu appears, Press the F4 key to select the Protocol Analyzer.
4.	When the Protocol Analzyer's main menu is displayed, press the A key to select Monitor/Eumulate/record/Playback.
	RESULT: The TEST OPERATIONS menu is displayed on your screen.
5.	Press the Right Arrow key three times; enter TEATT as the set-up file name and press the ENTER key.
	RESULT: The parameters shown in Figure 4-12 are loaded into all Test Operations and Emulation submenus.
6.	If required, change any Test Operations or Emulation submenu parameters to match the requirements of your application.
7.	After all submenu parameters have been entered correctly, do the following:
	a. Press the RUN/HALT key to initiate the test
	b. Waut for SYNC to appear in the STATUS menu

Table 4-6
AT&T Telephone Emulation Set-Up (Functional Mode — Continued)

STEP	ACTIVITY
8.	Press the ESC key. **RESULT:** The ISDN BASIC RATE TERMINAL EMULATION run-time screen is displayed. 
9.	Press any of these keys during the test. The Protocol Analyzer monitors both the data it transmits and the data it receives in response. a. V to place or accept a call b. H to terminate a voice call c. S to send a SPID request d. E to send an EPSM request e. X to send a CRV audit f. A to send a TEI audit g. RUN/HALT to end the test

4.4.5 Emulating an Northern Telecom Telephone in Functional Mode

Figure 4-13 shows the TC1000 Protocol Analyzer emulating a Northern Telecom ISDN telephone. Connection to a Northern Telecom DMS 100 ISDN network is established using RJ45 connectors on the S bus. In this configuration, you can use the Protocol Analyzer to emulate the TE side of a Basic Rate Interface (BRI) in functional mode, and test conformance to Layer 2 and Layer 3 ISDN protocol standards by doing any or all of the following:

- initating or accepting a call (call set-up)
- terminating (i.e., "hanging-up") a voice call (call tear-down)
- sending a TEI audit

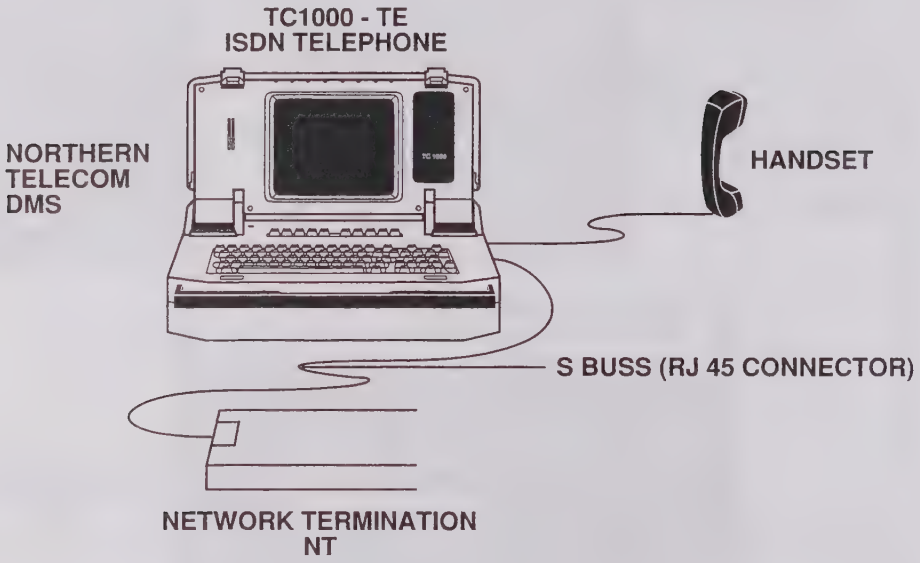


Figure 4-13
Emulating a Northern Telecom Telephone in Functional Mode

Parameter Settings:

For purposes of example only, this application assumes the setting of these parameters:

Level 1:			Level 2:			Level 3:		
Level 1 Interface	=	Basic Rate	Level 2 Protocol	=	LAPD	Level 3 Protocol	=	Q.931
Line Loading	=	100 Ohms	Sig. Channel	=	D	DN	=	4159675400
Clock Speed	=	192 kb/s	Sequencing	=	Modulo 128	Level 3 Switch	=	NTI DMS 100
Emulation	=	TE	k	=	2	B-Chan. Function	=	Voice
			T200 Timer	=	1			
			T203 Timer	=	20			
			N200	=	5			
			N204	=	1			
			TEI Address	=	Automatic			

Application Set-Up File:

The application file TENTF enables your Protocol Analyzer to emulate a Northern Telecom telephone in Functional mode. When loading this file (using the SETUP NAME submenu of the TEST OPERATIONS screen), all application submenu parameters are automatically set as shown in Figure 4-14. If any parameter does not match the requirements of your application, you can enter the correct parameter manually.

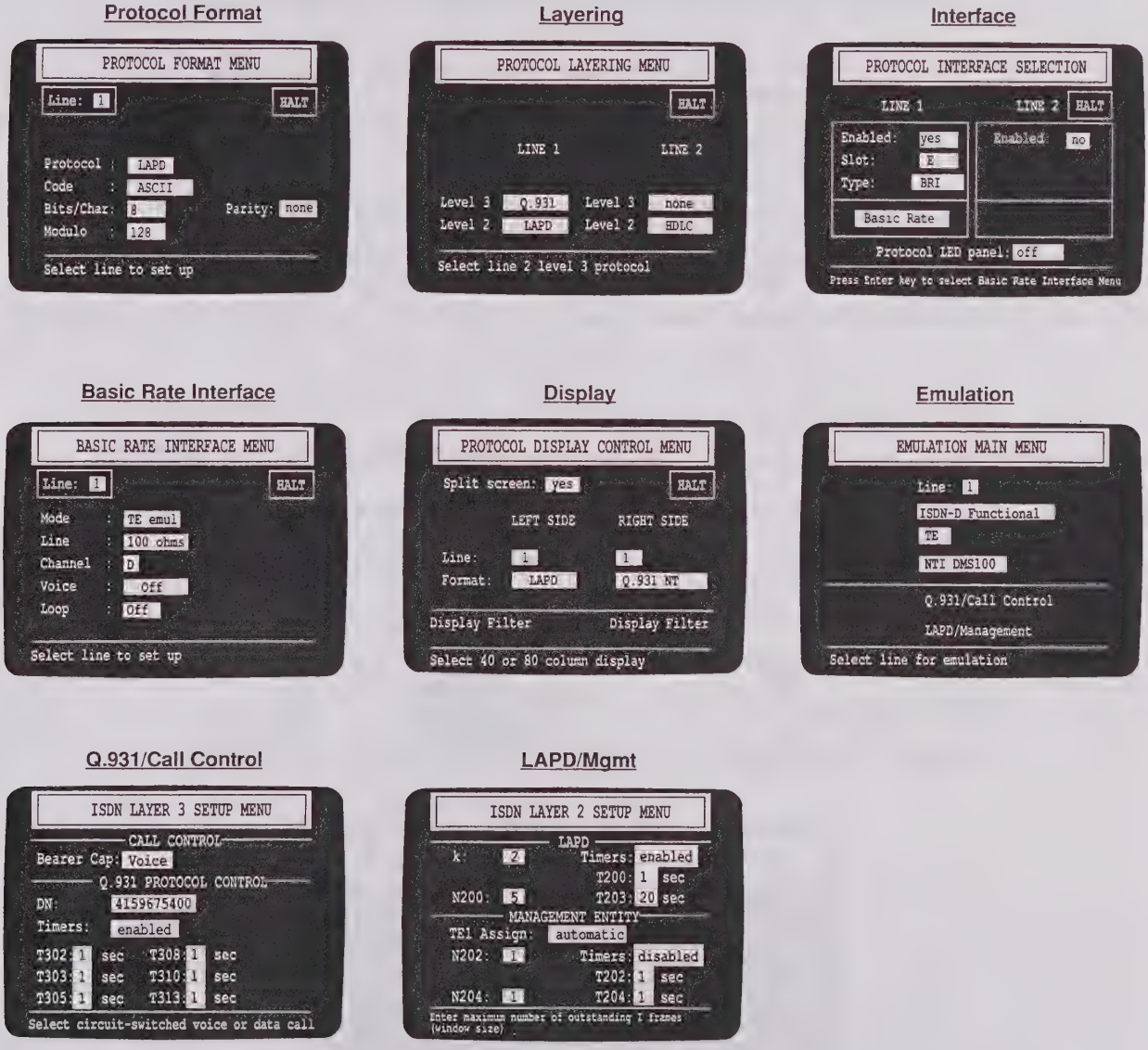


Figure 4-14
TENTF Application File — Automatic Set-Ups

Northern Telecom Network Emulation Test Set-Up (Functional Mode)

To set up the TC1000 or TC2000 for Northern Telecom telephone emulation in Functional mode, follow the steps listed in Table 4-7.

Table 4-7
Northern Telecom Telephone Emulation Test Set-Up (Functional Mode)

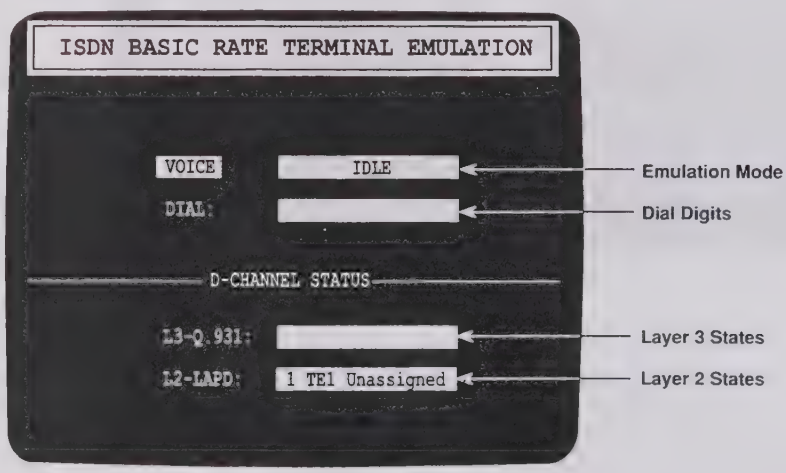
STEP	ACTIVITY
1.	Using the appropriate cables, and with power OFF, connect your Protocol Analyzer to the ISDN DMS 100 network as shown in Figure 4-13.
2.	After cabling, press the POWER switch to apply power to the Protocol Analyzer.
3.	When the main menu appears, Press the F4 key to select the Protocol Analyzer.
4.	When the Protocol Analzyer's main menu is displayed, press the A key to select Monitor/Eumulate/record/Playback. **RESULT:** The TEST OPERATIONS menu is displayed on your screen.
5.	Press the Right Arrow key three times; enter TENTF as the set-up file name and press the ENTER key. **RESULT:** The parameters shown in Figure 4-14 are loaded into all Test Operations and Emulation submenus.
6.	If required, change any Test Operations or Emulation submenu parameters to match the requirements of your application.
7.	After all submenu parameters have been entered correctly, do the following: a. Press the RUN/HALT key to initiate the test b. Wait for SYNC to appear in the STATUS menu
8.	Press the ESC key. **RESULT:** The ISDN BASIC RATE TERMINAL EMULATION run-time screen is displayed. 

Table 4-7
Northern Telecom Telephone Emulation Set-Up (Functional Mode — Continued)

STEP	ACTIVITY
9.	Press any of these keys during the test. The Protocol Analyzer monitors both the data it transmits and the data it receives in response. a. V to initiate or accept a call b. H to terminate a voice call c. A to send a TEI audit

4.4.6 Emulating an Northern Telecom Telephone in Stimulus Mode

Figure 4-15 shows the TC1000 Protocol Analyzer emulating a Northern Telecom ISDN telephone. Connection to a Northern Telecom DMS 100 ISDN network is established using RJ45 connectors on the S buss. In this configuration, you can use the Protocol Analyzer to emulate the TE side of a Basic Rate Interface (BRI) in stimulus mode, and test conformance to Layer 2 and Layer 3 ISDN protocol standards by doing any or all of the following:

- initating or accepting a call (call set-up)
- terminating (i.e., "hanging-up") a voice call (call tear down)
- send a TEI audit

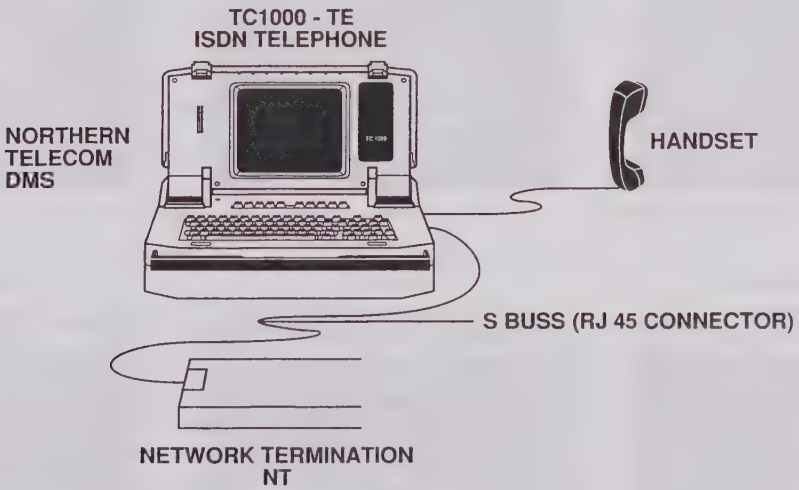


Figure 4-15
Emulating a Northern Telecom Telephone in Stimulus Mode

Parameter Settings:

For purposes of example only, this application assumes the setting of these parameters:

Level 1:			Level 2:			Level 3:		
Level 1 Interface	=	Basic Rate	Level 2 Protocol	=	LAPD	Level 3 Protocol	=	Q.931
Line Loading	=	100 Ohms	Sig. Channel	=	D	Release Code	=	02
Clock Speed	=	192 kb/s	Service-Type	=	SAPI 16/Voice			
Emulation	=	TE	Sequencing	=	Modulo 128			
			k	=	2			
			T200 Timer	=	1			
			T203 Timer	=	20			
			N200 Timer	=	5			
			N204 Timer	=	1			
			TEI Address	=	Automatic			

Application Set-Up File:

The application file TENTS enables your Protocol Analyzer to emulate a Northern Telecom telephone in Stimulus mode. When loading this file (using the SETUP NAME submenu of the TEST OPERATIONS screen), all application submenu parameters are automatically set as shown in Figure 4-16. If any parameter does not match the requirements of your application, you can enter the correct parameter manually.

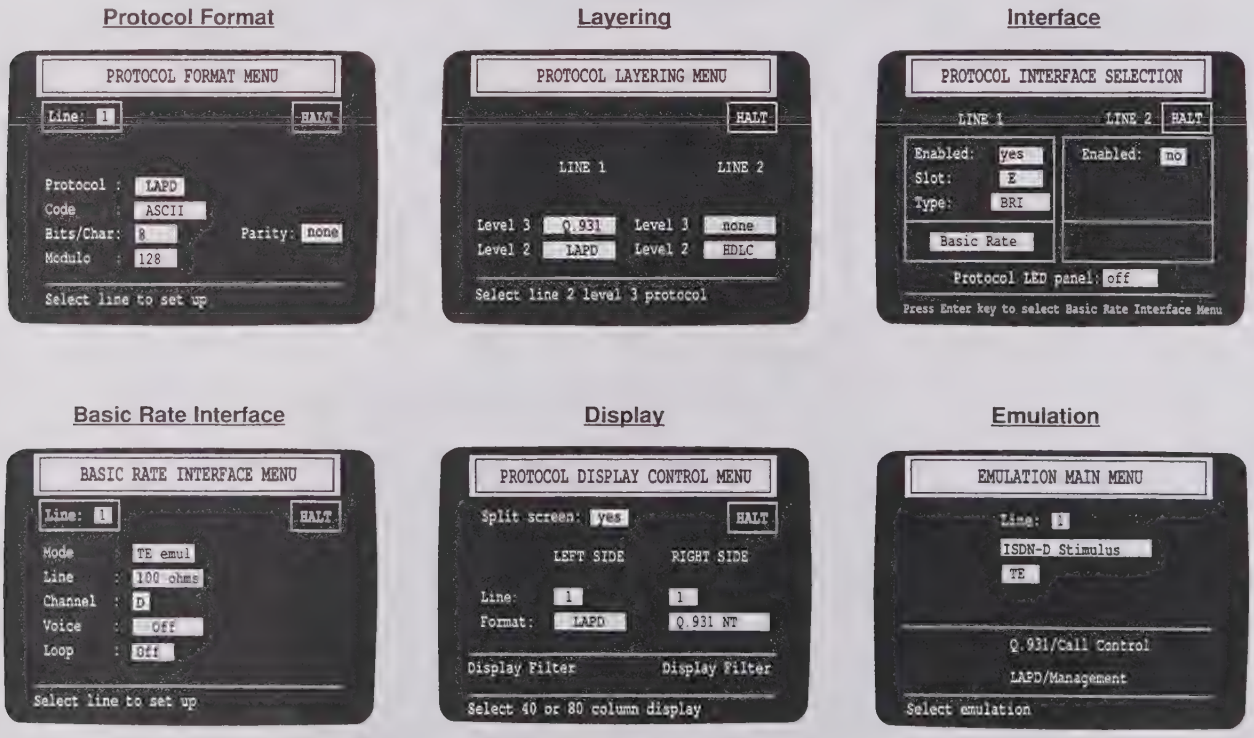
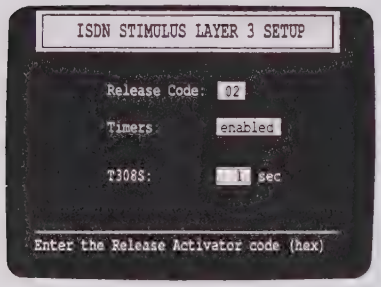


Figure 4-16
TENTS Application File — Automatic Set-Ups

Q.931/Call Control



LAPD/Mgmt

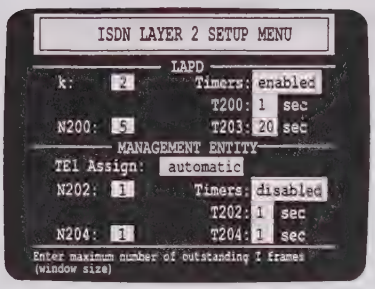


Figure 4-16
TENTS Application File — Automatic Set-Ups (Continued)

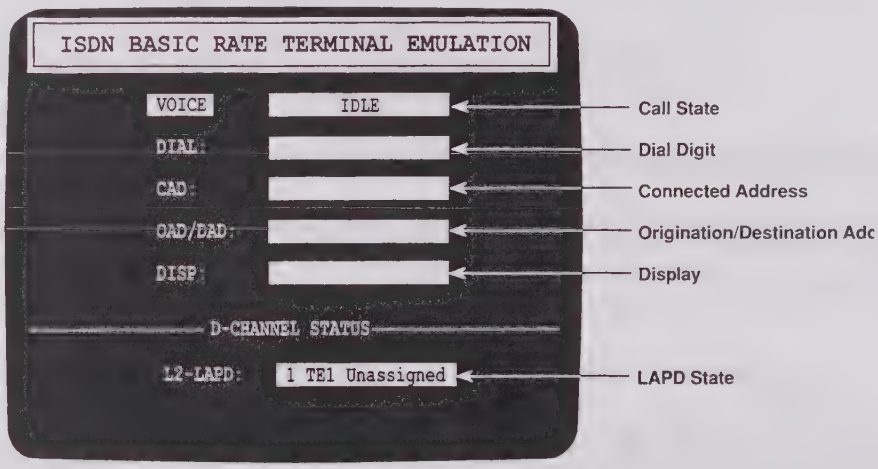
Northern Telecom Telephone Emulation Test Set-up (Stimulus Mode)

To set up the TC1000 or TC2000 for Northern Telecom telephone emulation in Stimulus mode, follow the steps listed in Table 4-8.

Table 4-8
Northern Telecom Telephone Emulation Test Set-Up (Stimulus Mode)

STEP	ACTIVITY
1.	Using the appropriate cables, and with power OFF, connect your Protocol Analyzer to the ISDN DMS 100 network as shown in Figure 4-15.
2.	After cabling, press the POWER switch to apply power to the Protocol Analyzer.
3.	When the main menu appears, Press the F4 key to select the Protocol Analyzer.
4.	When the Protocol Analzyer's main menu is displayed, press the A key to select Monitor/Eumulate/record/Playback. **RESULT**: The TEST OPERATIONS menu is displayed on your screen.
5.	Press the Right Arrow key three times; enter TENTS as the set-up file name and press the ENTER key. **RESULT**: The parameters shown in Figure 4-16 are loaded into all Test Operations and Emulation submenus.
6.	If required, change any Test Operations or Emulation submenu parameters to match the requirements of your application.
7.	After all submenu parameters have been entered correctly, do the following: a. Press the RUN/HALT key to initiate the test b. Wait for SYNC to appear in the STATUS menu

Table 4-8
Northern Telecom Telephone Emulation Test Set-Up (Stimulus Mode)

STEP	ACTIVITY
8.	Press the ESC key. **RESULT:** The ISDN BASIC RATE TERMINAL EMULATION run-time screen is displayed. 
9.	Press any of these keys during the test. The Protocol Analyzer monitors both the data it transmits and the data it receives in response. a. V to initiate or accept a call b. H to terminate a voice call c. A to send a TEI audit

APPENDIX A
GLOSSARY

23B+D - In ISDN, the components of the Primary Rate Interface (PRI), which includes 23 64 kb/s B channels and one 64 kb/s D channel.

2B+D - In ISDN, the components of the Basic Rate Interface (BRI), which includes two 64 kb/s B channels and one 16 kb/s D channel (144 kb/s).

AMI - Alternate Mark Inversion. Electrical U interface line coding.

ASP - Assignment Source Point.

AT&T - American Telephone and Telegraph.

B Channel - In ISDN, the portion of a circuit that is dedicated to transmitting voice or data between users. Also known as the *Bearer Channel.*

BERT - Bit Error Rate Test.

BRI - In ISDN, the 144 kb/s Basic Rate Interface, carried over the Digital Subscriber Line (DSL). As defined by the CCITT, a DSL consists of two 64 kb/s B channels that transmit voice and/or data, and one 16 kb/s D channel that transmits signaling information.

CAD - Connect Address (Northern Telecom Stimulus).

CO - Central Office.

CEI - Connection Endpoint Identification.

CCITT - The International Telephone and Telegraph Consultative Committee.

CPE - Customer Premise Equipment.

CR - In ISDN, the Command/Response bit found in LAPD.

CME - Connection Management Entity.

CRV - Call Reference Value. In ISDN, the CRV is the Layer 3 value that identifies a call set up.

CPE - Customer Premise Equipment.

D Channel - In ISDN, the portion of a circuit that is dedicated to the exchange of signaling information.

DAD - Destination Address (NTI Stimulus mode).

DCE - Data Communications Equipment.

DSL - Digital Subscriber Loop.

DTE - Data Terminal Equipment.

GLOSSARY (Continued)

EA - In ISDN, the extension bit found in LAPD.

EPSM - Endpoint Service Message.

HDLC - Higher Level Link Control.

HIC - Highest Incoming Logical Channel.

HOC - Highest Outgoing Logical Channel.

HTC - Highest Two-way Logical Channel.

IE - ISDN Layer 3 information elements.

I Frame - A LAPD/LAPB information frame which contains the Layer 3 of either Q.931 or X.25.

ISDN - Integrated Services Digital Network.

ISO - International Standards Organization.

k - The number of LAPD information frames which can be outstanding at any given time.

LAPB - Link Access Protocol on the B channel.

LAPD - Link Access Protocol on the D channel.

LAPD States - The state of an NT's LAPD Layer 2, which determines what stimuli and responses are generated. These LAPD states are displayed on your TC 1000 or TC 2000 Protocol Analyzer.

1 - TEI Unassigned
2 - Assign Wait TEI
3 - Estab Wait TEI
4 - TEI Assigned
5 - Awaiting Establishment
6 - Awaiting Release
7 - Multiframe Established
8 - Timer Recovery

LIC - Lowest Incoming Logical Channel.

LOC - Lowest Outgoing Logical Channel.

LTC - Lowest Two-way Logical Channel.

Modulo 8 or 128 - In HDLC and LAPD, the sequence number of frames transmitted and received. For example, Modulo 128 denotes the wrapping of this sequence from 127 to zero.

Multiframe - In LAPD, the mode which permits more than one frame to be outstanding without an explicit acknowledgement.

N(R) - LAPB/LAPD receive sequence number.

GLOSSARY (Continued)

N(S) - LAPB/LAPD send sequence number.

N2 - In LAPB, the number of retransmissions of unacknowledged frames that may occur without initiating recovery.

NT - Network Termination. Usually refers to Central Office telephone switching equipment.

NTI - Northern Telecom Inc.

OAD - Origination Address (NTI Stimulus).

PAD - Packet Assember/Disassembler.

PCM - Pulse Code Modulation.

PLP - Packet Layer Procedure.

PRI - Primary Rate Interface. In North America, the PRI consists of 23 64 kb/s B channels and one 64 kb/s D channel.

P(R) - X.25 Packet Level receive sequence number.

P(S) - X.25 Packet Level send sequence number.

PSN - Packet Switched Node.

PVC - Permanent Virtual Circuit.

Q.921 - The CCITT recommendation which describes ISDN link access procedures on the D channel. Also known as *Layer 2* or *Link Layer*.

Q.931 - The CCITT recommendation which describes the ISDN Layer 3 signaling procedures protocol stack. Also known as *Layer 3*.

RED - Redirection Address (NTI Stimulus).

SABM(E) - Set Asynchronous Balanced Mode (Extended).

SAPI - Service Access Point Identifier.

SPID - Service Profile Identification.

SVC - Switched Virtual Circuit.

TA - Telecommunications Computer.

TC - Terminal Adaptor.

TE - In ISDN, terminating equipment. Usually refers to telephones.

TEI - In ISDN, a series of Layer 2 bits that declare the terminal endpoint identifier.

TID - Terminal Identification.

GLOSSARY (Continued)

UI - In ISDN, an unnumbered Q.921 information frame. This type of frame sends no sequence number and does not require acknowledgement.

USID - User Select Identification.

W - The X.25 packet window size.

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